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Agriculture

Technical and Scientific Papers
presented at

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MANITOBA AGRONOMISTS' ANNUAL CONFERENCE

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TECHNICAL AND SCIENTIFIC PAPERS PRESENTED AT

1986

MANITOBA AGRONOMISTS'

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ANNUAL CONFERENCE OF MANITOBA AGRONOMISTS

Agriculture Auditorium, Faculty of Agriculture
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December 10 and 11, 1986

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Pedigreed Seed Usage on Manitoba Farms 1981 - 1985

J.R. Rogalsky
Manitoba Agriculture

During the past 30 years, 5 seed grain surveys were conducted by Manitoba Agriculture to determine the quality of seed used by Manitoba farmers. The surveys were undertaken in 1954, 1955, 1965, 1976 and 1981.

The survey method used in most of these years involved Manitoba Agriculture regional staff (mainly agricultural representatives) obtaining samples of seed directly from farmers seed drills during the spring seeding operation. The samples were then analyzed by the Agriculture Canada Plant Products Seed Laboratory to determine the seed grade.

The number of samples obtained in the 5 surveys ranged from 568 to 886 per year of survey. The survey results provided useful information, but were based on a relatively small number of samples i.e. an average of about 750 samples from 30,000 to 40,000 farms in the province. For this reason the survey results were frequently viewed with some skepticism. Did they reflect a true picture of the quality of seed used on a province wide basis?

In 1981, the Manitoba Crop Insurance Corporation devised a detailed questionnaire to be completed by farmers that carry crop insurance. The questionnaire asked many specific questions about the agronomic practices used by individual farmers, and was completed during an interview with the crop insurance agent. One question pertained directly to the quality of the seed used in establishing his crop - was it pedigreed, non-pedigreed, or was the pedigree unknown? The following information was derived directly from crop insurance records, and is based on the total acreage of four crop kinds insured during the years of 1981 to 1985 inclusive:

Red Spring Wheat

Year	Total Insured Acres	% of Provincial Plantings	Pedigreed	Non Pedigreed	Pedigree Unknown
1981	1,093,441	30%	25%	67%	7%
1982	1,081,619	28%	32%	63%	3%
1983	1,375,152	31%	38%	57%	3%
1984	1,550,112	37%	39%	56%	3%
1985	1,462,068	32%	40%	55%	3%
Increase over 5 years			15%		

Barley

Year	Total Insured Acres	% of Provincial Plantings	Pedigreed	Non Pedigreed	Pedigree Unknown
1981	740,092	31%	28%	63%	8%
1982	628,309	31%	40%	55%	4%
1983	596,162	34%	43%	52%	3%
1984	762,638	42%	43%	53%	3%
1985	734,977	40%	45%	50%	3%
Increase over 5 years			17%		
Flax					
1981	278,920	40%	37%	52%	9%
1982	331,585	37%	50%	43%	5%
1983	281,113	37%	51%	44%	4%
1984	477,242	48%	64%	30%	4%
1985	435,590	41%	62%	30%	6%
Increase over 5 years			25%		
Canola					
1981	215,649	36%	73%	17%	9%
1982	292,397	34%	81%	13%	4%
1983	364,337	38%	90%	6%	3%
1984	545,893	45%	91%	5%	3%
1985	435,122	44%	91%	3%	4%
Increase over 5 years			18%		

The foregoing information shows a substantial increase in the usage of pedigreed seed during the past 5 years. Since it is based on the total insured acreage for each crop kind, it should also serve as a valid indicator of pedigreed seed usage in the entire province. If the questionnaire results continue to be made available on a yearly basis, it will be possible to measure annual advances or declines in pedigreed seed usage in future years. In addition, it will be possible to compare pedigreed seed usage on a regional basis, if sufficient funds for computor use can be made available.

REVISIONS TO THE SEEDS ACT AND REGULATIONS

- Y. Singh, Agriculture Canada

THE SEEDS ACT

In December 1985, revisions to the Seeds Act received Royal Assent and became law. The revised Act contains the following changes:

(a) Authority to write regulations pertaining to the use of variety names in advertising seed.

(b) Increased penalties for violations under the Act. For summary convictions maximum fines have been increased from $500 to $25,000, whereas maximum prison terms have been increased from six months to one year. For convictions by indictment, maximum fines have been increased from $2,000 up to any amount set by the court, whereas maximum prison terms have been increased from one year to five years.

(c) A registration system has been introduced to replace the present licensing system. This new registration system will allow day-to-day amendments of the variety list whilst maintaining its legality.

(d) The definition of "sell" has been amended to cover contractual agreements.

(e) Authority to provide for bonding of imported seed on the premises of the importer.

SEED REGULATION AMENDMENTS

1. Weed Seed Order

Amendments to the Weed Seeds Order were gazetted on September 2, 1986, but will not take effect until July 1, 1987. Until then, the present Weed Seeds Order will remain in effect. The new Weed Seeds Order contains the following changes:

(a) Twenty-one new weeds have been added to the Prohibited Noxious Category List. Nineteen of these weeds (numbers 9 - 29 inclusive in the New Weed Seeds Order) are poisonous. The remaining two new weeds, Common crupina and Yellow starthistle, do not occur in Canada presently, but are becoming a problem in some U.S. border states.

(b) Canada thistle and bedstraw (cleavers) have been moved from Second Noxious to the Primary Noxious List. Two new weeds, velvet leaf and Johnson grass, have also been added to the Primary Noxious List.

(c) Mayweed, cowcockle, Persian darnel and scentless chamomile have been changed from "Other Weed Seeds" to Secondary Noxious.

(d) Wild oats will be considered a Prohibited Noxious Weed in Tables I, II and III species (these include cereals) when sold in the Province of Quebec, Nova Scotia, New Brunswick and Prince Edward Island.

(e) Round-leaved mallow will be considered a Second Noxious weed in lentils.

2. Grade Standards

Amendments to the grade tables were gazetted at the same time as the Weed Seeds Order and will also become law at the same time i.e. July 1, 1987. The following are the main changes:

(a) Germination standards remain essentially the same except for durum wheat and peas where the percentage germination is lower by 5%.

(b) Reduced allowance for weed seeds and other crop seeds in most grades. The reductions in weed seeds are greatest in the "total weed" seed content (see attached table for comparison).

(c) All No. 3 grades have been eliminated.

(d) All Canada No. 1 and No. 2 grades have been renamed Common No. 1 and Common No. 2, respectively.

(e) Pedigreed grades allow fewer impurities than "Common" grades at equivalent No. 1 and No. 2 designations.

(f) There is provision for only one grade of "Common" rapeseed.

(g) Hybrid corn and sunflower have been placed in a seperate table (VI).

(h) New standards have been established for:

    (i) B. campestris (Polish rape) in B. napus (Argentine rape) and vice versa;
    (ii) other Brassica species in rapeseed;
    (iii) other non-Brassica species in rapeseed;
    (iv) Sclerotinia sclerotiorum in rapeseed and sunflower;
    (v) true loose smut in barley.

(i) Two new grades of Certified forage mixtures have been added to the forage table (Table XII).

(j) Timothy has been moved from Table VIII (previously Table VII) to Table IX (previously Table VIII). The absence of hulls is no longer a factor in grading of timothy.

(k) There has been a numbering of the tables. Some of the tables retain the same numbers (e.g. cereals) whereas other tables (e.g. forage, lawngrass mixtures) have new numbers.

3. Information to Buyers of Seed

Revisions to section 14 of the regulations will, as of July 1, 1987, require sellers of seed to label seed packages or supply to buyers, at the time of sale, or within a reasonable period from that time, with the following information:

(a) The name and number of noxious weeds per unit weight;

(b) The total number of weeds per unit weight;

(c) The total number of seeds of other crops per unit weight;

(d) The percent germination of a representative sample of the seed and the date on which the germination test was completed.

4. Regulations Currently Being Considered

The following regulations are presently being considered for future implementation:

(a) Advertising of Seed;

(b) Importation of unregistered varieties;

(c) Sale of pedigreed seed in bulk between Authorized Establishments;

(d) Multiplication of seed under contract;

(e) Bonding of imported seed;

(f) General quality standards;

(g) Disease standards.

AIR SEEDERS - THEIR STATUS

By: **Claude R. Dubé**, P. Eng.
Regional Engineer
Manitoba Department of Agriculture, Brandon

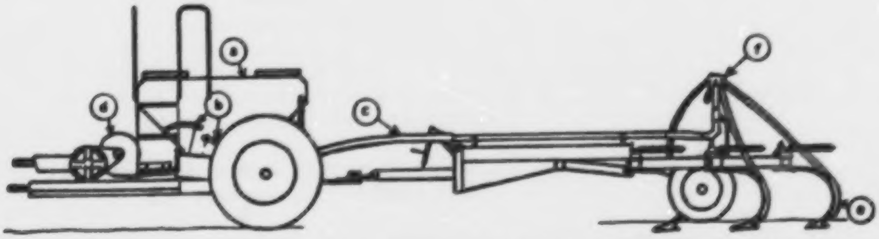
Introduction

Man has tried to find more efficient methods to seed and incorporate fertilizer in soil in order to grow a crop since the beginning of agriculture. The air seeder (pneumatic applicator) is the most recent technology devised for this purpose.

Air seeders have been introduced to the prairies in the early 1970's but only became a major force in the agricultural equipment market in the 1980's.

General Description

Air seeders are made up of various components. The first is a holding tank consisting of one or two compartments (refer to Fig. 1, a). Under each compartment is fitted a metering system (Fig. 1,b) to which one or more hoses (Fig. 1,c) are connected. These hoses combined with a fan (Fig. 1,d) act as the delivery system between the metering and incorporating functions. The other extremity of the hoses is connected to a seed placement device attached to a furrow opener (Fig. 1, e).

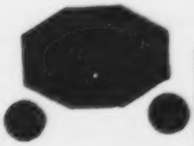


a - tanks; b - metering system; c - hoses; d - fan; e - placement device; f - header

Fig. 1
General Air Seeder Components

Description of Components

Tanks may come in various sizes, depending on the manufacturer. Most tanks consist of 2 separate compartments which can be used for both seeding and fertilizing or fertilizer banding only. Refer to Table 1 for a list of sizes as measured by the Prairie Agricultural Machinery Institute (PAMI).

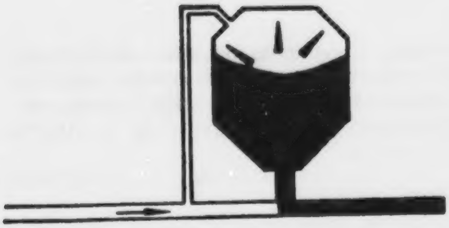


TANK CAPACITIES

	SEEDING		BANDING
	GRAIN cu.m	FERTILIZER kg	FERTILIZER kg
WIL-RICH 4150	0.94	580	1540
MORRIS M-600	1.35	1340	2675
JOHN SHEARER	1.82	1342	3175
CONCORD AS10002	1.82	1845	3628
LEON S-45	1.67	2177	3855
PRASCO 75-55	2.70	1900	4490
BOURGAULT 138D	2.10	2540	4535
FRIGGSTAD PA1-40	2.90	2245	4980
FLEXI-COIL	3.20	3311	6530
J.D. 665	4.10	2735	6800

Table 1

Tanks may be pressurized. This is dependant on the type of metering device used. Refer to Fig. 2a, b, c for the various types of metering devices with general comments about each. Table 2 shows the range of fertilizer banding capabilities of various manufacturers as tested by PAMI.



A

Pressurized Tank

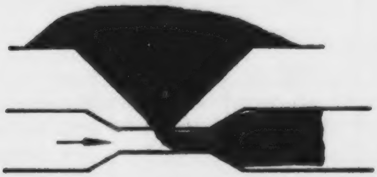
*Sealed

*No Moving Parts

*Usually Used With Belt Or Roll Metering System

*Tank Must Remain Sealed

*High Capacity

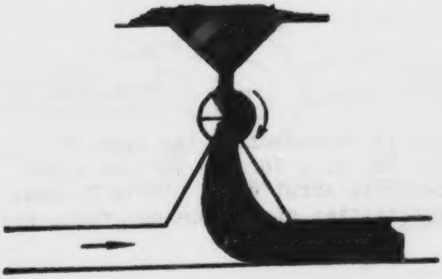


B

Venturi

*No Moving Parts

*Rate Range Limited By Orifice (Usually Low)



C

Air Lock

*No Need For Pressurized Tank

*Moving Parts

*High Capacity

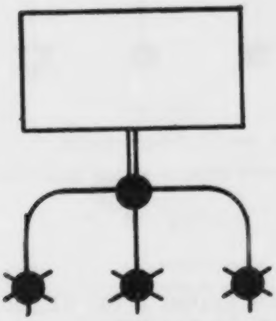
FERTILIZER BANDING CAPABILITIES

AIR SEEDER	kg/ha
BOURGAULT 138D	220 - 330
MORRIS M-600	
J.D. 665	
WILRICH 1150	
PRASCO 75-55	
CONCORD AS1002	
JOHN SHEARER MK3	330 - 440
FRIGGSTAD PA1-40	
FLEXI-COIL	
LEON S-45	

Table 2

After the grain has moved through the metering system it has to be transfered to the soil by means of a pneumatic system. The air is forced in the hoses by the use of a fan. Fans usually operate between 3400 and 6000 r/min. They require 9 to 15 kW to operate. They may be driven with a PTO, hydraulic motor or with an engine.

There are 3 basic types of delivery systems. The Type "A" System (Fig. 3) consists of 1 large diameter hose delivering all the metered material to the primary header or manifold with up to 8 ports.



TYPE "A"

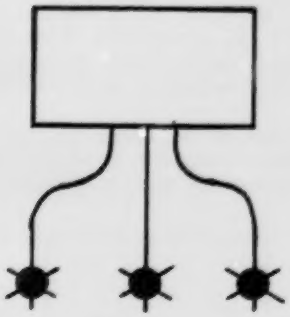
- 1 PRIMARY AND UP TO 6 SECONDARY HEADERS OR MANIFOLDS
- 1 METER
- UNIFORMITY MAY BE A PROBLEM

Fig. 3

Each port is connected to a secondary header which may have up to 12 ports. From these ports material is delivered to the seed placement device.

The advantages of this system is that only one metering device is required and the tank is usually pressurized. One great disadvantage is that pattern uniformity may be a problem. The metered material is delivered into one airstream and reliance is put into the headers to distribute it evenly across the unit. Effectiveness may be affected by a pressure change downstream from the primary header.

The Type "B" delivery system (Fig. 4) is similar to type "A". The difference is that one metering system is used for each secondary header. All types of metering systems may be used with this unit. The application uniformity is usually better than the type "A" unit.



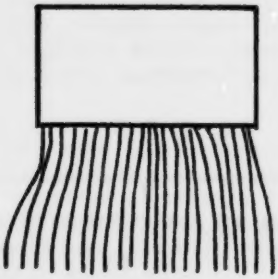
TYPE "B"

- 1 METER PER SECONDARY HEADER

- UNIFORMITY USUALLY BETTER THAN TYPE "A"

Fig. 4

The Type "C" delivery system (Fig. 5) does not have any headers. All the hoses are attached to the metering device. This system is usually more expensive than the previous two. The metering device is usually a wide metering roll conbined with a wide venturi to which all the hoses are attached. Application accuracy may be affected by side-slope.



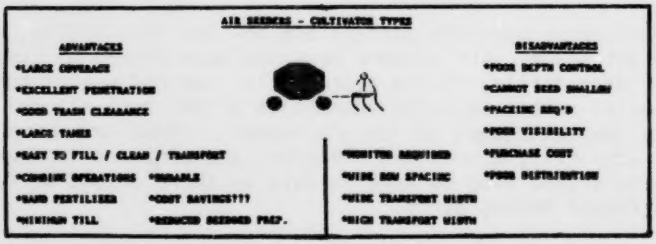
TYPE "C"

- SEVERAL METERS
- UNIFORMITY USUALLY BETTER

Fig. 5

Not only is it important to meter the material accurately and distribute it as evenly as possible across the seeding implement, it is just as important to incorporate the material to an even depth.

The first type of air seeder utilized a cultivator. The shanks were fitted with seed boots or banding knives. There were various problems associated with this unit. The advantages and disadvantages of the cultivator type unit are mentioned in Table 3.



AIR SEEDERS - CULTIVATOR TYPES

ADVANTAGES

*LARGE COVERAGE
*EXCELLENT PENETRATION
*GOOD TRASH CLEARANCE
*LARGE TANKS
*EASY TO FILL / CLEAN / TRANSPORT
*COMBINE OPERATIONS
*DURABLE
*BAND FERTILIZER
*COST SAVINGS???
*MINIMUM TILL
*REDUCED SEEDBED PREP.

*MONITOR REQUIRED
*WIDE ROW SPACING
*WIDE TRANSPORT WIDTH
*HIGH TRANSPORT WIDTH

DISADVANTAGES

*POOR DEPTH CONTROL
*CANNOT SEED SHALLOW
*PACKING REQ'D
*POOR VISIBILITY
*PURCHASE COST
*POOR DISTRIBUTION

Table 3
Advantages & Disadvantages of Cultivator Type Air Seeders

Packing has also been found to greatly reduce the risk of seeding failure. One of the original problems found with the cultivator type units was the lack of soil-seed contact. Packing as shown in Table 4 greatly increases the yield. If the original yield is considered to be "X", the next phase would increase the yield by up to 200 kg/ha in wheat.

RESEARCH RESULTS WITH CULTIVATORS

		YIELD kg/ha
A)	NO PACKING	X
B)	1-PASS PACKING	X + 200
C)	2-PASS PACKING	X + 270
D)	3 + PASS PACKING	X + 270 + LITTLE

Table 4
Packer Yield Results With Wheat

Depth control has been addressed in the last few years with the aid of electronics. Depth controllers have been introduced on the market. Problems with these units still occur. PAMI has evaluated some units. Better controls are being introduced every year but more research and evaluation are required to perfect these systems.

Cultivator type air seeders are not the only systems existing in the market place. Air seeders have now been fitted to discers, hoe drills, disc drills, double disc drills, and rod weeder hoe drills. These units combine all the advantages of the conventional units and some of the advantages of the air seeder. These are large tanks; easy fill, access and cleaning; and constant implement weight. The units should also be more durable as there should be fewer small and intricate moving parts.

Future of Air Seeders

Skepticism shown from various professionals in the field of agriculture with regards to air seeders has slowly changed to conviction that pneumatic applicators have a place in agriculture. Economics have dictated this change. Large, high horsepower tractive units must be used more efficiently. Research has shown that fertilizer deep banding seems better than surface broadcasting. Less cultivation is required with some types of applicators. Therefore, minimum tillage can be practiced. Labor is also a factor. With the low rate of return for farm products, these units require less labor and all material can be handled in bulk. These units are usually larger than their conventional counterparts; therefore less time per area covered is spent for each pass.

One challenge that will need to be addressed in the future is the hitching of these larger units. They will require little time and effort to convert them from field to transport position and vice versa.

Air seeders are here to stay and will take their place along with all other implements used in agriculture in the past, present and future. Problems are surmounted every year and new ideas introduced to make the air seeder more efficient and easier to use.

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BIOGRAPHY

Claude R. Dubé, P. Eng.

Regional Engineer

M.D.A. - Southwest Region

Brandon

- Graduate of University of Alberta
- Designed potato handling equipment and industrial loaders
- Started for M.D.A. in April 1982
- Tested various air seeders in 1983 and 1984

THE PROS AND CONS OF STRAW BURNING

The argument as to whether stubble burning is a good or bad practice has been going on for many years. For every person that says stubble burning is bad there is one that says stubble burning doesn't hurt anything or anyone and in fact is necessary.

This paper attempts to take an unbiased look at stubble burning from several perspectives including the chemcial and physical effects on the soil; the economics of burning versus non-burning; management considerations and environmental considerations.

Organic Matter: Crop residue is an important source of soil organic matter. The subsequent breakdown of organic matter provides vital plant nutrients such as nitrogen. As well, organic matter plays an essential role in maintaining soil tilth.

It is a well documented fact that since prairie soils were broken their organic matter content has decreased by approximately 50%. There are those who maintain that soil organic will stabilize at or about current levels because of the decrease in summerfallow and the move towards continuous cropping. This appears to be not necessarily so.

Soil samples submitted to the Provincial Soil Test Lab were analyzed for organic matter content in 1978 and again in 1985. Three major soil types, namely the Newdale, Red River, and Osborne soils were included in the test which showed a decline of 0.16%, 0.21%, and 0.19%, respectively (Table I). Despite continuous cropping, which has been a common practice on the Red River and Osborne soils for many years, it is apparent that organic matter is not at equilibrium.

Table I[*1]

Organic Matter Content Of Farm Samples In 1978 And 1985

	- - - -1978- - -		- - - -1985- - -	
	No. Samples	O.M.%	No. Samples	O.M.%
Newdale	636	5.56	338	5.40
Red River	83	5.78	103	5.57
Osborne	92	5.68	70	5.49

This trend can be demonstrated by working through an equation for estimating organic content decline over time.

This equation: $OM_R = \frac{A}{r} + (OM_o - \frac{A}{r}) E^{-rt}$[*2]

*1 - R. A. Hedlin, 1986. Personal Communication.

*2 - Adapted from Bartholomew and Kirkham as shown in Nitrogen in Agricultural Soils (F.J. Stevenson, Ed). Soil Science Society of America. Agronomy 22, 1982. Chapter I. Origin and distribution of N in Soil. pp. 1-39.

Where: OM_R = Organic matter remaining after time (kg/ha)

OMo = Organic matter at time zero (kg/ha)

A = Humus produced after 1 year of decomposition (kg/ha)

r = Rate of decomposition of humus (% per year)

t = Time in years

In order to work through the equation, a number of assumptions have been made. It must be recognized that there are many variables that would influence the results.

The assumptions that were made are as follows:

1. That an average crop of wheat (2000 kg grain/ha) produces 3500 kg/ha of straw and 1500 kg/ha of roots and exudates.
2. That the rate of decomposition of soil humus is 1.6% per year.
3. That 259 kg of humus is produced per 1000 kg of straw returned to the soil.
4. That the present organic content is 5.66%.

It was further assumed that wheat was grown continuously for seven years. When all of the crop residue was returned to the soil, the organic matter content at the end of the 7 years was 5.49% - a drop of 0.17%.

When 60% of the crop residue was burned, as would be the case in windrow burning, the organic matter content at the end of the seven years was 5.31% - a decline of 0.35%.

If you follow the scenario on into time, it was predicted that organic matter level will stabilize at 4.05% if no residue was burned but only at 2.34% if the windrows were burned.

You must realize that these are not absolute values but they suffice to support the trend.

Now let us take another scenario and compare seven years of continuous wheat with a rotation which includes two crops of flax and one of canola.

Table 2

Seven Year Residue Load Under Continuous Wheat And A Wheat, Flax, Canola Rotation

	Continuous Wheat		Wheat Flax Canola	
Year	Crop	Kg Residue/ha	Crop	Kg Residue/ha
1	Wheat	4320	Wheat	4320
2	Wheat	4320	Flax	1560 (624)*
3	Wheat	4320	Wheat	4320
4	Wheat	4320	Canola	4400
5	Wheat	4320	Wheat	4320
6	Wheat	4320	Flax	1560 (624)*
7	Wheat	4320	Wheat	4320
Total		30240		24800 (22928)*

* Numbers in brackets represent the residue returned after flax straw windrows are burnt.

Table 2 illustrates that there could be a potential total of 30240 kg/ha of crop residue produced over seven years in the continuous wheat rotation but only 24800 kg/ha of residue when the rotation includes flax and canola - providing nothing is burned.

Realistically, it is quite safe to say that not all of the flax straw is worked back into the soil. The majority is either burned or baled. The effect of introducing flax into the rotation was that the organic matter content ended up at 5.34% after 7 years.

These theoretical calculations allow for some guesses to be made about the influence of various crops in continuous cropping rotations. Comparing the results of the two rotations on organic matter indicates that growing flax twice in seven years has a similar effect to always burning the windrows of wheat straw. Flax returns less residue to the soil, therefore organic matter will inevitably decline when flax is included in crop rotations. These calculations demonstrate that crop choice and amount of residue returned to the soil are important considerations in the organic matter cycle.

What does this mean in terms of nitrogen fertilizer? It appears that in the short-term burning the crop residue reduces the requirement for nitrogen fertilizer and in the long-term when soils reach a new equilibrium, the difference in nitrogen fertilizer requirements are negligible. It must be remembered that this considers N fertilizer only and not other soil factors which may influence crop yield and efficiency of N utilization.

There is a valid explanation for the two positions that farmers take relative to those that say that they do not burn and grow good crops as opposed to those who do burn - and still grow good crops.

In the case of those who do not burn, the added residue maintains the nitrogen-supplying ability of the soil at a higher level. However, much of the N mineralized is re-cycled in maintaining soil organic matter.

On the other hand, where straw is burned there is not the demand for nitrogen to decay the straw, therefore any nitrogen that is mineralized in the soil is more likely to be available for next year's crop. Although less fertilizer is required in this case, it comes as a cost to soil reserves of organic matter and nitrogen.

Organic matter is bound to decline when residue is burned. This is not the only detrimental effect. Researchers in Saskatchewan have shown that there is a reduction in hydraulic conductivity, an increase in bulk density or soil compaction, greater erosion potential, lower mineralization of nitrogen and lower microbial activity. This loss of soil quality must be balanced against the reduction of nitrogen fertilizer requirements in the short term.

The problem arises when the farmer who has always burned, decides that he is going to discontinue the practice. In these scenarios his nitrogen fertilizer requirements could increase from 89 kg/ha to 120 kg/ha per year, for many years, because not only is there an N requirement to feed the crop, there is a high nitrogen requirement to decompose the residue.

In terms of the costs of physically handling crop residues, it doesn't cost much to strike a match. After a burn, most fields are worked only once with a heavy duty cultivator, because there is very little residue to contend with, unless, of course a heavy fall growth is started, then the field may be worked again.

If the straw is not burned, it must be put through a straw chopper and spread. It costs between $1.00 and $1.50 per hour in extra fuel alone to power a straw chopper. If the straw is finely chopped and well spread, it is usually possible to get away with one operation with a heavy duty cultivator but our recent tillage survey indicates that many fields are worked twice at a cost of some $7.00 per hectare - not including labor. If the field is plowed with a moldboard plow, costs are more like $19.00 per hectare.

Management: Tillage is not the only cost. Crop residue - as humus, plays an important role in maintaining soil tilth - the workability of the soil; it improves precipitation infiltration, preventing puddling and crusting of the soil surface after a rain. The humus also acts as a binding agent, reducing soil erosion and seedling damage through sand blasting. The crop residue also protects seedlings from heat blast.

Many farmers who burn use the argument that black soil will warm up faster in the spring and they get better germination in the warm soil, particularly in a wet spring. The opposite in fact could be true.

Because evaporation is a cooling process and although the exposed soil is dryer, it could also be cooler. Work by Bonnefoy and Friesen verified this.

On the other hand, a blanket of straw may conserve soil moisture and reduce soil moisture loss through evaporation. This is particularly important on the lighter textured soils.

Preparation of a good seedbed seems to be the predominant thinking behind straw burning. This is an equipment issue more than anything else. The crop residue is burned because some seeding equipment will not work satisfactorily if there is any amount of trash on the land at seeding time.

The difficulty of handling crop residues is being compounded by the ever increasing size of combines and swathers. In spite of the efficiency of the new straw choppers, it is almost impossible to spread the huge swathers uniformly back on the land. The blanket of chaff that falls directly behind the combine is still a problem because it doesn't go through the straw chopper and it isn't readily spread by harrows.

There are times in spite of a farmers good intentions not to burn, when he doesn't have much of an alternative. The fall of 1985 is a good example.

When the grain is tough and the straw is tougher and the days are short and rain is forecast, the straw chopper is often the first thing to go. In that case, there isn't much alternative but to burn, and we had better appreciate the farmer's position before we say that what they are doing is wrong.

Health And Environment: The Manitoba Department of Environment receives hundreds of complaints every fall from people who, for one reason or another, find the smoke from stubble annoying.

From a health standpoint, the Winnipeg hospitals report a marked increase in the number of patients being admitted with respiratory problems during the stubble burning period.

I suspect that those people involved in the multi-car pile-up in North Dakota last fall would agree that it was not the healthiest place to be - especially the two that were killed, if they were still here.

In summary, there appears to be justification to say that straw burning is enhancing the degradation of the soil base. If crops such as flax are included in the rotation the effect on soil organic matter is almost the same as if cereal crop residue is consistantly burned.

In the short-term, nitrogen fertilizer requirements are reduced where straw is burned but at the expense of maintaining soil organic matter. In the long-term, soil organic matter will stabilize at a considerably lower level in soils on which crop residue has been burned. However, once equilibrium has been reached, nitrogen fertilizer requirements will be the same regardless of whether straw has been burned or worked in.

There will be either an increase in cost as a result of higher nitrogen requirements, or a decrease in yield if these higher N requirements are not met when a farmer who has consistently burned his straw decides that he is going to work the straw in. These increased costs will continue until such time as soil organic matter is returned to a level where mineralization can contribute significantly towards the N required to decompose the increased amount of residue returned.

There are more farmers that do not burn, than there are farmers that do burn, in all areas of the Province, which proves the point that straw burning is not necessary.

One of the major factors that contributes to straw burning is the lack of seeding equipment that will work efficiently where there is any amount of residue on the soil surface at seeding time.

There is increasing evidence that the smoke from stubble fires creates both an environmental and health hazard and these may well be the determining factors as to whether or not straw burning becomes a regulated practice.

INOCULATION AND N^2-FIXATION IN GRAIN LEGUMES

K.W. Clark
Department of Plant Science
University of Manitoba
Winnipeg, Manitoba
Canada, R3T 2N2

In this presentation I shall attempt to draw upon examples from the grain legumes currently grown in Manitoba, i.e., Peas, Lentils, Fababeans, Field Beans and Soybeans, but I shall also include some examples in the role of inoculants in improving N^2 fixation of other crops we grew in 1986 - Chickpeas, Tangier Pea and Peanuts and for Western Manitoba perhaps throw in an example from work on Lupins.

We all recognize that high energy costs have been felt by farmers in the increased costs of fertilizer, in particular nitrogen. As approximately 20% of the worlds food comes from legumes, the use of dinitrogen fixation has become increasingly important, not only in developing countries where most of the grain legumes are consumed but here in N. America also where such grain legumes are, under conditions of continuous cropping, playing a major role in maintenance of organic matter and soil nitrogen.

An overriding consideration as to which grain legume may be grown and how often comes from our plant pathologists in their recommendation that those legumes susceptible to certain pathogens be spaced at least four years apart in a cropping sequence. This being the case we know that Rhizobium spp. numbers will have declined to levels at which poor nodulation, retarded in time, can at best be expected. In fact we have noted fababean fields devoid of nodules which only three years previously had grown an excellent crop of this same legume (probably the same cultivar).

The role of legume inoculants is to provide sufficient root nodule bacteria for the legume to form nodules which will at least improve, and at best maximise, N_2 fixation. This improvement may be reflected in crop or forage yield, although benefits may also be obtained by reduction of the plant's dependence on available soil nitrogen which will not be reflected in plant yield.

Many authors recognise constraints in the role of inocula and the soils in which they are used. Differing perceptions of this role have recently produced divergent views on its fulfillment. Dawson (1970) advocates inoculation with effective rhizobia as "good insurance" - a common attitude which tends, too readily, to assume success. On the other hand, Alexander (1983) argues strongly that successful inoculation is not limited by lack of highly effective strains but by lack of strains adapted to ecologically significant stresses in the soils. This sentiment is also followed by Newbould (1983) who concludes that we have not translated the "vast........ knowledge on......nodulation of temperate legumes to widespread and consistent practical use in the field".

Responses to inoculation may be anticipated if naturalized or native rhizobia are either ineffective, non-effective due to low numbers, or absent. We know also that grain production can be improved in the presence of a soil population of 3000 rhizobia/g of soil. Rhizobium leguminosarum the species which nodulates Peas, Lentils, and Fababeans may be widely distributed in European soils, but U.K. institutes now, in the 1980's, consider inoculation beneficial due to reduced numbers after continuous cereal cropping.

All the rhizobia spp. infecting peas, fababeans, lentils, vetches, chickpeas and field beans are fast growers, with *R. leguminosarum* being the type species of the genus, so there has been an abundance of studies conducted on Host Cultivar X Rh Stain interactions, etc. Here in N. America, the inoculant production companies package, when known, the most infective and effective strains available for the cultivars of grain legumes being grown in a region.

Environmental Constraints

From the variety of inoculant responses in the literature it is clearly impossible to predict the need for inoculation in many situations, particularly in an environment new to the crop. Apart from interaction with physical variables it is even possible that the choice of the wrong test host cultivar could provide incorrect information on compatability with local rhizobia. The greater problem however, is the lack of knowledge of the effect of other factors in expression of a response, e.g., nutrient limitations, especially phosphorus. For this reason there remains a strong case for support for proposals made in recent years for simple, definitive designs to separate the contributions made by inoculation and non N fertilizers and to examine the effect of N fertilizer as a control.

Technological Constraints

The grain legumes of interest are essentially temperate, cool season growers so that inoculant transport and storage of inoculants tends to be during favourable temperatures. We did identify in Canada a problem in the early 80's, due to rapid packaging and shipment to cold warehouses before #'s had built up in the packages. Currently the bulk of the inoculant used in Canada is from the Nitragin Co. of Milwaukee which uses a pre-sterilized and dried peat carrier with sufficient broth culture added to reach the required final moisture level. Gamma-irradiated peat is now the preferred carrier and is used in Australia, N.Z., Brazil and South Africa. This year we had one such inoculant from Agricultural Genetics Co. of U.K. which has an agreement with the Ag and Food Research Council to develop commercially microbial inoculants and biological control agents. They are merchandizing Rhizobium inoculants, biological control agents, VAM and other Rhizobacteria.

I understand a γ-irradiated peat based inoculant from one other U.K. company was sent into Ontario this year - soybean inoculant, and I also know that frozen paste and freeze-dried cultures were shipped from U.K. to one U.S.A. company.

Despite the pre-eminence of peat as a carrier, its good conditions are not readily definable (Strijdom 1981) beyond Date's (1974) criteria of high organic matter, high water holding capacity, low soluble salt content and nutritive characters supporting survival of the rhizobia. The search for alternatives has continued especially with the emphasis on development of inoculant industries in the more tropical countries, where peat is generally not available. Many alternatives have been tested alone and in combination including soil, charcoal, coir dust, alfalfa meal, cereal straws, rice husks, corn cob meal, filter mud and in our studies chickpea and lentil straw. In North Dakota they have even tried lignite coal dust. All these carriers share with peat the variation in quality and lack of precise definition of desirable characters. Hale (1985) claimed an internationally available inorganic carrier of excellent value but it has not been identified and we have only had one sample. We have had some success in the amendment of our carriers with a water holding inorganic polyacrylamide called Agrosoke but its cost may not warrant its use in the production of inoculants.

Despite photographic evidence that *Rhizobium* cells at a concentration of 10^9 g^{-1} are widely spaced on the surface of ground peat carrier used for Australian inoculant (Dart et al. 1969) it has proved difficult to consistently increase populations to apparently achievable levels of 10^{10} or greater. Roughley and Thompson found that provided broth exceeded 5 x 10^8 cells per ml^{-1} the final number of *Rhizobium* in peat cultures was unrelated to inoculum size. Meade *et al.* (1985b) have achieved some increases by concentration of cells before addition to peat.

The principle of pre-packaging has become progressively more widely adopted. The stability of more resistant plastic films also allows wider use of autoclaving as a means of sterilization. Gamma irradiated packets of finely ground peat are available for export from Australian inoculant manufacturers to allow local producers to prepare their own inocula. There is clearly a potential for many centres to provide such a product, enabling countries which lack carriers or expertise to develop them, to manufacture their own inoculant by only owning a fermenter. We should be doing this here in Manitoba for we have identified some of the best peat sources in the world.

While fermenters can range from simple aerated glass flasks to 1,000 L capacity or more, small producers can utilise fermenters of *ca* 20-30 L capacity particularly if they can take advantage of diluted cultures for inoculation (Somesagaran and Halliday 1982). However not only the cost and practicality of some available fermenters are not necessarily satisfactory (see Roughley 1986) but it is also necessary to purchase an autoclave for sterilization. Built in steam heating coils (which can double for cooling) or units which may be heated externally as a pressure vessel to ensure sterilization are more practical alternatives.

Freeze-drying (lyophilization) is a standard storage technique for bacteria, and some companies are attempting to merchandise freeze-dried inoculants but there is an appreciable cost involved. Kremer and Peterson (1983) have found that survival of lyophilized rhizobia at 60°C was improved by suspension in a vegetable oil carrier, but claims for superiority of this combination to peat-based inocula were not supported by valid comparisons, and data for survival on seed were not presented.

The use of oil carriers has been most strikingly illustrated by the technique of suspension of broth culture in nontoxic oil (of either plant or mineral origin) through which a dry gas such as air can be bubbled to reduce the moisture content of the rhizobium cells (U.S. Patent No. 3,340,968, May 12, 1962). The final product can be sold as a liquid inoculum to which fungicide and/or molybdenum may be added. Alternatively, the dried cells (generally 1 to 10% moisture) are concentrated by centrifugation, and mixed with vermiculite which thus has an oil texture, assisting adherence to the seed without wetting (Gault 1981). Allelix produced several oil-based inoculants for soybeans which were used in 1985, but they have currently shut down this research. Results to date of such planter-box inoculants have not been promising in terms of rhizobium viability or success in inoculation. Skipper et al. (1980) found disappointing results with non-peat-based products and with combination products containing Mo and/or fungicides. No product as yet has attempted to combine the potentially protective attributes of lypholization and a γ-irradiated peat carrier. This is what we would like to do here in Manitoba in the development of a Canadian Inoculant industry. I should interject here that we foresee this industry to be the producer of Biocontrol and Rhizobacteria inoculants for cereal and special crops as well as Rhizobium inoculants for our grain and forage legumes. The first Canadian research papers on the use of such inoculants are now reaching us for review and the results presented look very promising. Several Canadian biotechnology companies are involved in such research.

While much of the impetus for improvement in developing countries relates to risk of exposure to high temperature, the results point clearly to the need for adequate testing of all stages of all new processes, particularly if the physical state of rhizobia is likely to be adversely affected during the process. Few authors have addressed these problems and it is a salutary lesson to find that innovative products are being accepted on the commercial market, and then subsequently found to be inferior to other, albeit conservative, inocula. It is also important to appreciate that existing simple technology has potential in the right hands. One manufacturer in Brazil produces in three months, 1,000,000, 200 g packets of high quality inoculum by the simple stab inoculation of irradiated peat carrier (Roughley, 1986). Relative to the requirement for high temperature tolerance, we have in our Co-op project with ICARDA selected Rh cicer strains tolerant to 36°C temperature, a significant improvement over Mid-East native strains.

Numbers of Rhizobia

Background soil populations of rhizobia often outnumber inoculant rhizobia numbers. A population of 10,000 rhizobia per gram of soil, assuming uniform distribution to a depth of 15 cm is equivalent to approximately 2.25×10^{13} rhizobia per hectare. Using an inoculant containing 1×10^{9} rhizobia per gram the unknown rhizobia may outnumber it by factors between 90:1 to 450:1 depending on host species (Table 1). These differences are exacerbated by any loss of viability of the inoculant, between its introduction into soil and the development of a host rhizosphere.

For any situation, a knowledge of the size of the naturalized population is necessary for the formulation of a strategy for legume establishment:

(i) In the absence of rhizobia, standard inoculation procedures are satisfactory.

(ii) Where small numbers of rhizobia are present, more sophisticated methods may be required.

(iii) Where naturalized populations of rhizobia are large, inoculation is futile and useful levels of nitrogen fixation can only be achieved with a legume that is symbiotically compatible with the existing rhizobia.

(iv) Inoculant success may necessitate host-symbiont genetic compatability and exclusion of resistant rhizobium infection.

Meade et al. (1985b) have achieved some increases by concentration of cells before addition to peat but suggest that there may be a maximum cell density which can be accommodated in peat carriers and that very high cell densities cannot avail of the protective effect exerted by peat.

Strain Selection

For all our grain legumes we have numbers of excellent strains available for use in inoculant production. Placement of granular soil implant inoculants below the seed have given good results but cost is an added factor and gandy-type fungicide applicators must be used on the seed drill. These granular inoculants are generally more protective in dry soil conditions, but increasing the dose rate of a fine seed applied peat inoculant may do as good a job.

Although Chatel and Greenwood (1973) and Chatel and Parker (1973) demonstrated that clover rhizobia most competitive in nodule formation and persistence in the field were often those isolated from similar environments, Thompson (1986) has claimed that the case for ecological superiority of "local" isolates as inocula is not established, as the numbers of strains evaluated are so few. However there is a stronger case for use of host centres of diversity as sources of rhizobium strains thus giving a greater chance of finding symbiotically suitable strains (Lie 1985, Thompson 1986) and this has been demonstrated particularly with Pisum by Lie and his associates (e.g. Lie and Goktan 1984).

Application of Inoculant

Successful legume inoculation is dependant on viability of the inoculant from the time of its introduction into the soil until the rhizosphere influence of the host is sufficient to support bacterial growth. Ideally, seed, freshly inoculated with high quality culture, is sown into moist soil but in practice, seed is often sown into soil that is chemically and physically unfavourable for the survival of the inoculant due to high temperature and moisture deficit. Fig. I illustrates available strategies for maximizing nodulation by rhizobia introduced into hostile environments. One means of increasing rates of inoculation is to use adhesives effective in binding the inoculants to the seed; e.g., the best adhesives used by Elegba and Rennie (1984) bound > 800 mg of inoculant per seed of soybean equivalent to $> 1 \times 10^6$ viable rhizobia per seed. We are continuing with seed coating research. In some circumstances, alternatives to seed coat inoculation seem desirable (i) when pesticides, applied as seed dressings, are necessary; (ii) when the logistics of conventional inoculation of large quantities of seed impose a constraint on the speed of sowing large areas; (iii) with fragile seeds, e.g., peanuts and chickpeas; (iv) with species whose seed coats contain substances toxic to rhizobia, e.g., Sainfoin; (v) with legumes, e.g., soybeans, which lift the seed coat out of the soil during emergence so that many of the rhizobia on the seed coat are not deposited in the soil; (vi) when the dimensions of the seed surface limit the number of rhizobia that can be applied; it may be necessary to exceed the limit with very small-seeded legumes or when resident rhizobia present strong competition to the inoculant, e.g., Rh. japonicum strain 101 (non-effective on 00 and 000 soybeans) but is highly competitive against strains 110, 138 and 122 used in Nitrogen Co. inoculant.

The alternative of seed bed inoculation utilizes solid and liquid inoculants. Solid inoculant (soil implant) normally consists of peat culture as granules or as a coating attached with adhesive to a solid core. Liquid inoculant is made by suspending peat or frozen concentrate in water. The suspension is carried in a tank mounted on the tractor and, under pressure generated by a small pump, is sprayed into the seed bed through clear plastic capillary tubes mounted behind the seed boot. Fluid drilling of phaseolus beans has become a popular seeding method in several countries and where pre-soaking of legume seeds is practiced the liquid inoculant is the preferred route.

Preinoculation, often used with small seeds (alfalfa), is the inoculation of seed before sale and involves a period of storage prior to sowing. One objective is to allow seed merchants to stockpile inoculated seed to meet predictable heavy demand by farmers at times when sowing deadlines are imposed by climate. Various processes for preinoculation have been developed but is is difficult to maintain biological standards between preparation and use. As a result, preinoculation has received unfavourable appraisal, e.g., Brockwell et al. (1975), Schall et al. (1976). Our Canadian inoculant monitoring group have often reported sub-standard levels of viable rhizobia. Thompson et al. (1975) have made several recommendations pertaining to quality control. Nevertheless, preinoculation is an attractive proposition for both seed merchant and farmer and endeavours continue to develop a process that will at once apply a large population of rhizobia to the seed and preserve its viability over several weeks.

The most promising development has been the recent use PVP (polyvinyl-polypyrrolidone). The insoluble form, chosen as a phenolic adsorbent to minimise the adverse effects of toxic seed coat substances was successful in laboratory plate studies of seed diffusates (Hale & Mathers 1947, Materon & Weaver 1984). Subsequently the use of soluble PVP applied with the R. trifolii inoculum to a pre-coated seed of white clover resulted in greatly improved survival (Coated Seed Limited 1981), although the data do not exclude the possibility that improved survival was due to protection from other factors such as desiccation.

Standards

Canada is one of the few countries which has set Federal standards through Plant Products Division of C.D.A. They require minimum numbers of infective bacteria using a PEPI test.

Ideally standards are set to ensure the maximum number of infective rhizobia in the inoculant at point of use. In practice maximum numbers have generally been achieved in the absence of contaminating organisms in the carrier (e.g. peat, Roughley and Vincent 1967) and clearly any concentrated inoculant prepared from a bacterial growth medium such as dried or lyophilised cells will need to be essentially free of contaminants. There is a degree of pragmatism in implementing this standard in Australian inocula - gamma irradiation at 50 Mrads does not necessarily kill all organisms in peat (Parker and Vincent 1981) so the standard implemented is the requirement that the contaminant organisms do not exceed 0.1% (Roughley and Pulsford 1982). Prior to introduction of irradiation, contaminating organisms were acceptable and the only criterion was numbers of infective rhizobia. Numerical standards have risen since the use of irradiated peat and good quality peat or solid carrier inoculum may reasonably expect to provide at least 10^9 rhizobia g^{-1} - the minimum standard now adopted in a number of countries. However there is increasing evidence that increasing numbers of rhizobia for seed well above the levels provided by such carriers containing 10^9 cells per gram can improve nodulation. As a limitation then is that of ensuring adhesion of greatly increased quantity of carrier, the development of higher counts in the carrier is favoured. With small aerated fermenters, *Rhizobium trifolii* populations can readily reach and maintain 5 x 10^9 cells per ml of broth (Roughley and Pulsford (1982) but it has proved difficult to produce peat inocula with more than this number per gram especially with some slow growers. The potential of concentrated dried cells (e.g. Kramer and Peterson 1983) to satisfy the numerical requirement needs to be confirmed in terms of survivors on seed.

North American Biotechnology companies are working diligently in this regard as are many research institutes. There is, however, still much to be done in extension of known technology in upgrading inoculant use by our pulse crop growers in Western Canada. The economic benefits to improved dinitrogen fixation can be highly significant if all legumes are properly inoculated.

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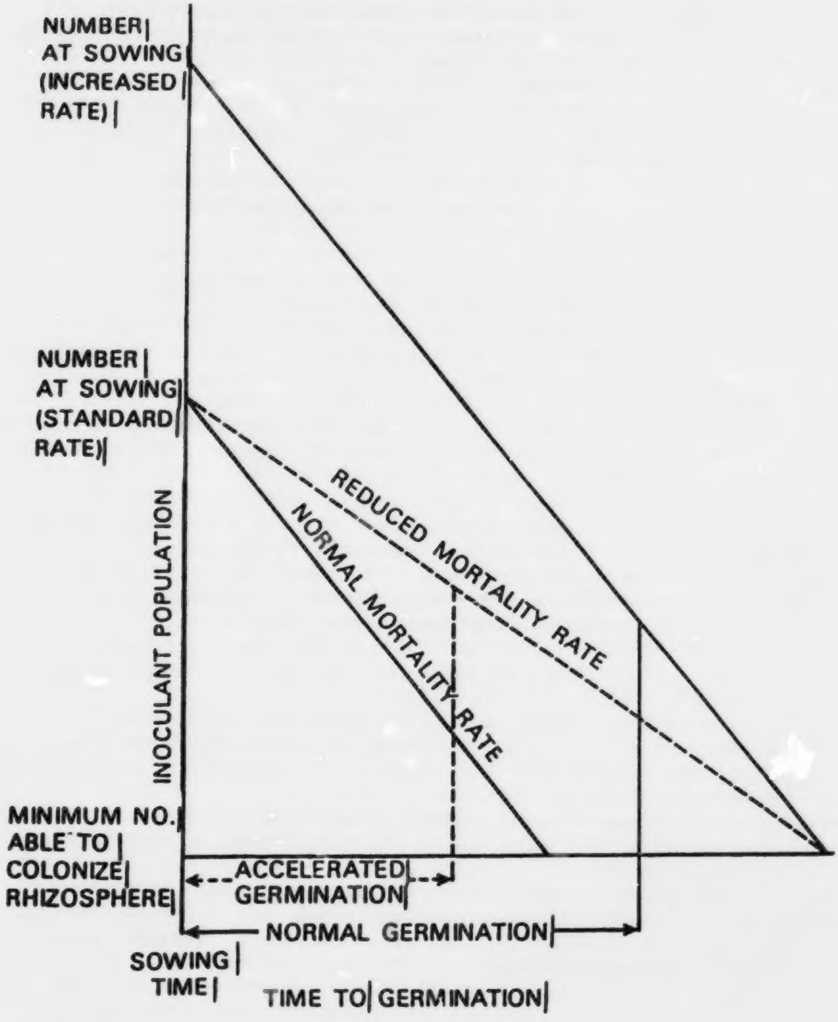
NUMBER AT SOWING (INCREASED RATE)
NUMBER AT SOWING (STANDARD RATE)
INOCULANT POPULATION
REDUCED MORTALITY RATE
NORMAL MORTALITY RATE
MINIMUM NO. ABLE TO COLONIZE RHIZOSPHERE
ACCELERATED GERMINATION
NORMAL GERMINATION
SOWING TIME
TIME TO GERMINATION

Fig. 1. A schematic illustration of factors involved in improving the likelihood of nodulation (after Brockwell 1977):

(i) reducing inoculant mortality rate

(ii) increasing rate of inoculant application

(iii) decreasing time to germination (and formation of a rhizosphere).

Table 1. Numerical relationship between numbers of inoculant rhizobia introduced into soil by seed or granular implant and populations of background rhizobia already established in soil.

A. Fine Peat Slurry-inoculants

Crop	Inoculant rate /(kg) seed[3]	Recommended Sowing rate kg/ha[4]	Grams inoculant per Ha	Rate of Introduction Rhizobia/ha[1]	Ratio of Inoculant Rhizobia to soil[2]
Alfalfa	4.0 grams	7	28	2.8×10^{10}	1:800
Chickpeas	4.0 grams	≅ 145	≅ 580	5.8×10^{11}	1: 40
Field Peas	4.0 grams	170 - 200	680 - 800	$6.8 - 8.0 \times 10^{11}$	1: 33
Lentils	4.0 grams	35 - 80	140 - 320	$1.4 - 3.2 \times 10^{11}$	1:160
Field Bean	4.0 grams	45 - 70	180 - 280	$1.8 - 2.8 \times 10^{11}$	1:125
Fababean	4.0 grams	135 - 200	540 - 800	$5.4 - 8.0 \times 10^{11}$	1: 42
Soybean	3.3 g/kg	130	430	4.3×10^{11}	1: 50

B. Granular Implant Inoculant

Crop	Inoculant rate /(kg) seed[3]	Recommended Sowing rate kg/ha[4]	Grams inoculant /kg seed	Rate of Introduction Rhizobia/ha[1]	Ratio of Inoculant Rhizobia to soil[2]
Lentil	≅ 5.6 kg/ha	35 - 80	70 - 160	5.6×10^{12} cells/ha	1:4
Fababean	≅ 5.6 kg/ha	135 - 200	28 - 41		
Chickpea	≅ 5.6 kg/ha	≅ 130	43		

[1] Assuming 10^9 cells/gram inoculant.

[2] Assuming a population of background rhizobium of 10,000 cells/gram of soil uniformly distributed to 15 cm depth.

[3] A North American Manufacturers recommended rate.

[4] Manitoba seeding rates.

Table 2. Pulse crops in Manitoba. Based on 1986 acreage estimates.

	Acres	Yield	Unit Value	Total Value	Seed Required For This Area
Field peas	160,000	25 bu	$5.00	$20.00 m	9500 t
Lentils	65,000	900	23¢	$13.46 m	1200 t
Field beans	16,000	1500	28¢	$ 6.72 m	450 t
Fababeans	11,500	1800	9¢	$ 1.86 m	950 t
Soybeans	5,000	26 bu	$5.00	$ 0.65 m	275 t
				$42,690,000	

Table 3. Analysis of variance for various components as affected by inoculation rate, soil and chickpea type.

		Mean squares			Mean squares		
Source	df	shoot DW (/plant)	shoot total N(mg/plant)	df	micromoles C_2H_4 (/plant/hr)	nodule DW (/plant)	nodule number (/plant)
Inoculation rate (A)	5	2.673***	2189.0***	4	147.580***	0.249***	4653***
Soil type (B)	1	0.498*	272.923*	1	11.415 NS	0.087**	250.104*
Chickpea type (C)	1	20.151***	3914.355***	1	14.298*	0.038*	3382.504***
A x B	5	0.180 NS	219.834**	4	36.115***	0.008 NS	299.271**
A x C	5	0.198*	323.974***	4	5.518 NS	0.024**	710.692***
B x C	1	0.004 NS	62.087 NS	1	1.151 NS	0.001 NS	69.338 NS
A x B x C	5	0.109 NS	20.903 NS	4	2.653 NS	0.007 NS	234.879*
Error	46	0.099	50.796	38	4.588	0.008	83.470

*, **, *** significance levels at the 0.05, 0.01 and 0.001 probability levels, respectively.
† Somasegaran 1985.

Seed Coating - Development and Utilization in Canada

Allan J. Klassen

CANADIAN SEED COATERS LTD.

Seed coating technology was developed and has been used successfully, in New Zealand since the 1950's. It was introduced into the United States a short time later.

Canadian Seed Coaters was established in 1977 as the first seed coating company in Canada, producing coated forage legume and turf grass seed in its plant at Brampton, Ontario.

A program to develop coated canola seed commenced during the winter of 1979-80. A prototype of the product, later to be named CanOcote was tested in field plots at Vegreville, Alberta in the spring of 1980. Based on the encouraging results from these and subsequent trials, a second coating plant was established at North Battleford, SK where commercial production began in January 1983.

With developments in equipment and processes, it is now technically feasible to coat virtually any kind of seed with a vast array of materials. However, several conditions must be satisfied for a coating process to be commercially viable.

1. The coating must provide some demonstrable benefits to the producer in terms of convenience, safety, reduction of production risks, or improvement in yield and/or crop quality.
2. The cost of coating the seed and delivering it to the farm must be less than the value of the benefits derived from its use.

Given present market conditions, the seed coating process is best suited to crops with low seeding rates and/or high unit value. Crops such as canola and forage grasses and legumes fit these criteria, although present market values for canola are not particularly favorable.

Cereal seeds can be coated effectively, but the costs associated with handling, coating and transporting the volume of seed required for a planting rate of 90-100 kg/ha tend to be prohibitive.

Coated canola represents the largest volume of Canadian Seed Coaters' production. Two products are presently being marketed.

CanOgard consists of an insecticide/fungicide treatment protected by a sealant coating. This coating results in a minimal increase in seed size.

CanOcote has the same insecticide/fungicide treatment plus an outer layer of super phosphate and the final sealant coating. This produces a substantial increase in seed size such that the final product is approximately two thirds seed and one third coating.

Prillon brand coated forage legume seeds are inoculated with appropriate strains of Rhizobium for nodulation and nitrogen fixation and the inoculant is then protected by a layer of phosphate and a sealant coating.

Advantages and Benefits of Coated Seed

1. Convenience and safety - There is no need for on-farm handling or exposure to hazardous insecticides and fungicides. Since these treatments are sealed onto the seed there is no loss of efficacy due to dusting off.
2. Increase in seed size due to coating allows better control of seeding rate and seed distribution.
3. Legume Rhizobia are protected from heat and light, thus ensuring better viability and superior inoculation.
4. Phosphate coating promotes better root growth and stand establishment.

Performance of coated canola seed in field trials conducted from 1981-85 by public and private researchers is summarized in Tables 1 and 2.

Results of 38 station years of data over the 5 years indicated an average yield increase of 8% for coated seed compared to conventional seed treatment with insecticide/fungicide.

A yield increase occured in 25 out of the 38 trials. In 6 trials there was no difference and in 7 trials coated seed yielded less than treated seed.

All varieties tested (Westar, Regent, Altex, Tobin, and Candle) performed similarly with average yield increases ranging from 2.8% for Altex to 11.9% for Tobin.

PRECAUTIONS - There are several factors which producers should be aware of when they begin using coated seed.

A moderate increase in seeding rate to compensate for the larger seed size may be desirable.

Seed drills equipped with a seed box agitator can cause excessive dusting or even crushing of CanOcote seed. If this type of drill is used the agitator system must be disconnected.

Seed coating is not a panacea or substitute for good management. Recommended practices of crop rotation, seed bed preparation, weed control, etc. are still important for maximum productivity.

The production and marketing operations of CSC are supported by an ongoing quality control program which measures germination characteristics of every lot of seed coming into the plant and every lot of coated seed going out to customers. In addition, physical characteristics of the coating are assessed to ensure that they meet predetermined standards.

Research activities have been expanded significantly within the last year and form an integral and important part of the company's operations. Objectives are to improve existing products and to develop new coating technology.

The level of interest in seed coating is illustrated by the recent establishment of Conder Coatings Ltd. in England, a joint venture with Twyford Seeds and current work on a plant in Finland.

Table 1. Performance of Coated Canola Seed in Western Canada (Average of all Cultivars)

YEAR	NO. OF STATION YEARS	YIELD (Kg/ha)	YIELD (% of treated control)
1981	12	1495	106.9
1982	2	1565	108.1
1983	8	1630	102.3
1984	7	1065	108.3
1985	9	1695	115.5
Average	38	1495	108.2

Table 2. Performance of Coated Canola Seed in Western Canada (1981-85)

VARIETY	NO. OF STATION YEARS	YIELD (Kg/ha)	YIELD (% of treated control)
Westar	10	1785	108.3
Regent	5	1345	109.7
Altex	7	1605	102.8
Tobin	12	1200	111.9
Candle	4	1655	108.3
Average	38	1495	108.2

"The Impact of New Methods of Pea Processing on the Food Industry"

When compared with mammoth corn and soy processing companies of the world, pea processing plays a very minor role. The entire pea processing capacity of Canada could fit into one production week of one large U.S. corn plant. But that is not to say that our industry cannot play a role in the world of engineered foods. The key to entry into that world involves two factors that food producers require: functionality and/or nutrition.

Functionality is the description given to food ingredients and the role they play in a food product. Most processed foods are actually complex systems of ingredients,each contributing some attribute toward the final product. These attributes may be the ability to emulsify oils as in a salad dressing or mayonnaise; or the ability to form a gel under certain conditions, as starch in a pudding with heat; or the protein casein in cheese with enzymes. Or it might be the contribution of color or flavor; or the ability to provide a particular texture or mouthfeel like proteins and oils in milkshakes; or the ability to hold particles in suspension like gums and pectins in ketchup. The ability to hold water decreases costs of products and enhances freshness and texture.

Most of these ingredients can be categorized as proteins, carbohydrates such as starches and sugars, fats and oils, or fibers. Modern food engineering assembles these ingredients to achieve an end product that is commercially successful at the lowest reasonable cost. Thousands of people are involved in the effort of mixing ingredients for new food products and for improving or reducing the costs of existing products. Obviously some are more successful than others.

At Woodstone Foods we process yellow field peas and extract the proteins, starches and fibers. The only basic food building block that we don't produce is fat. While peas have a fat content, that level is too low for commercial extraction. However, using our starches it is possible to produce a sweetener, fructose or glucose, using enzyme technology. Likewise enzymes can convert the pea proteins into meat flavors.

The key to the commercial possibilities is in the retention of desirable functions while removing the undesirable functions. The raw flavor of peas has kept the crop from being widely used in sensitive food products. I doubt that vanilla pudding lovers would accept a product that carried a pea flavor with the thickener starch but using the purified pea starch, the pudding can be thickened without any flavor change. In fact, our starch is lower in flavor than corn, potato or wheat starches and because it is stronger, less of it produces the same texture. In addition, it resists high cooking temperatures and can be heat sterilized without the pudding thinning.

However the product that is currently receiving the most of our attention is the fiber family. Dietary fibers have become much more prominent in our diets recently and having established the commercial viability of this nutritional trend, the food industry has been quick to provide finished products with varying amounts of fiber. One of the main problems facing the industry has been the availability of the supply of high quality vegetable fibers that would work well in sophisticated food systems. Traditional sources of roughage, such as wheat bran, tend to conflict with the smooth texture or light color traditional foods such as blueberry muffins or spaghetti sauce. Yet in order to market volume quantities of products, they had to conform to the consumers idea of what these foods should taste like. In an attempt to find fibers that could be hidden in food products without serious negative flavor or texture problems, the food industry went so far as to use wood fibers extracted from trees. This has met with some consumer resistance and the search continues.

Two of our products are vegetable fibers extracted from field peas. These products are washed and purified to provide ingredients which can be used in the most sensitive of applications. One of our fibers is used in the nationally marketed white fiber bread, Weston's "Fibre Goodness." This bread has the same fiber content as whole wheat bread yet looks and has the eating characteristics of a white bread. Another example is the fiber pasta produced by Catelli. "Fiber Plus" cooks and has the same characteristics as regular pasta but with a high fiber content.

Peas have a variety of dietary fibers from gums and pectins through hemi-cellulose and cellulose.These fibers contribute positively to food systems because they are separated from the accompanying flavors and other undesirable components. By separating and purifying the fibers and then recombining them in different ratios we can attempt to best satisfy the needs of a food product.

These fiber products are currently the object of most of our processing attention and may have some interesting implications for agriculture. They certainly seem to have filled a need in a new specialty niche in the food industry.

FIELD BEAN PRODUCTION

- John R. Dean, Manitoba Agriculture

In the space of 15 minutes it is not possible to tell you all there is to know about field bean production. There are a number of key things that can and should be said about beans in Manitoba, however, specially in December 1986.

Right now we are witnessing sky-high prices for navy or white beans. Manitoba producers have benefitted from this price in a way normally only dreamed of - the rare combination of high prices with exceptional yields and good quality. For some producers this has resulted in gross returns over $2400/ha which looks very attractive when compared to $320/ha for wheat!

Even though people realize this is a most unusual situation, the attraction of beans as a money-maker at a time when everything seems to be going the other way, is considerable.

It should be noted that one factor alone precipitated this extraordinary price for white (navy) beans - the disastrous weather at harvest time in both Ontario and Michigan, the major white bean producing areas in North Amberica (Table 1).

Table 1

Estimated Production of White & Coloured Beans, 1986

(Canada & U.S.)

	Acres	Yield (lb/ac)	Tonnes	% of Total	% Cdn Total
Ontario	125,000	1103	62,500	6.1%	75.8%
Manitoba	16,000	1500	10,883	1.1%	13.2%
Alberta	11,100	1800	9,060	0.9%	11.0%
Michigan	300,000	900	122,421	12.0%	
N. Dakota	275,000	1550	193,268	18.9%	
Minnesota	61,000	1550	42,879	4.2%	
#Other U.S.			580,598	56.8%	
Total			1,021,609		

#Includes Cal., Neb., Col., Idaho

As close to harvest as August 21st this year, price quotes in Fargo were $12 - $13 (U.S.) or $17 - $18 (Canadian) per cwt. At this level, a bean farmer with an excellent yield of 1680 kg/ha would barely cover his total costs. One month of bad weather in September changed everything.

So much for the current, unusual situation.

In this paper a number of features of bean production will be highlighted. First, the variety of beans grown in Manitoba and sold into both domestic and export markets. Secondly, a review of the prices paid to Manitoba producers for the past several years. Thirdly, a brief survey of the major production factors involved in raising beans, and finally look at production costs for beans versus wheat.

1. Beans in Manitoba

Field beans are usually divided into two major groups - the white, navy or as they are called in the Trade, pea beans, and then other beans which are designated "coloured" beans.

Table 2

Field Beans - Types Grown in Manitoba

Maturity	Type
Earlier (95-105 days)	Navy (White, Pea bean)
↓	Pinto
	Pink
	Red Mexican
	Black
	Dutch brown
Later (103-123 days)	Dark Red Kidney

White beans have white seed coats, while coloured beans range from black to pink to red to brown to mottled. In Manitoba, the 6500 hectares in production in 1986 was divided approximately 40% white beans, and the remainder split between blacks and pintos, with small acreages of pinks, dark red kidneys and others. Maturity ranges from 95 to 123 days depending on the variety and season, whites being the earliest maturing and dark red kidneys the latest. A lack of frost tolerance in the seedling stage means the crop should not be seeded before May 20. Frost can also cause havoc before maturity as happened in 1982 and 1985. Both loss of yield and quality and a dramatic increase in the cost of cleaning and processing the product was the result.

The major areas of bean production in Manitoba include Carman and Plum Coulee (where production was first attempted in the late 1960's), the Winkler area, Portage and a small acreage at Whitemouth. Enough heat to mature the crop (about 2400 CHU), with saline-free, well drained soils are necessary requirements. Otherwise, beans grow well on both heavier and lighter loam soils.

2. Prices Paid to Manitoba Growers

It is always risky quoting prices received for a product sold (specially when the price is high!), since someone is bound to think that's not what they got! The prices listed in Table 3 are probably close to the top of the market, and therefore reflect good averages for a given year.

Table 3

Field Beans in Manitoba, 1978-1986 - Average Yields & Prices

	Yield	Price/lb (c)			Avg.	Gross Return	
	(lbs/ac)	Whites	Dk Reds	Pintos	Price	($/ac)	($/ha)
1986	1500	52	54	23	40	600.00	1482.00
1985	860	21	29	25	24	206.40	509.81
1984	1132	26	36	23	26	294.32	726.97
1983	1065	33	32	23	30	319.50	789.17
1982	598	18	24	16	18	107.64	265.87
1981	1339	31	35	32	32	428.48	1058.35
1980	1082	25	35	--	28	302.96	748.31
1979	1325	25	25	--	25	331.25	818.19
1978	700	20	--	--	20	140.00	345.80

They do not include prices for spring contracts, for example, which in some years may have been lower than the post-harvest prices. This was decidely the case in 1986. There is also limited substitution of one bean for another in specific markets, particularly for white beans. This explains the dramatic increase in white bean prices but only a modest increase for pintos whose major production area is not in Ontario and Michigan.

The extreme vulnerability of Manitoba bean producers to price fluctuations is well illustrated by the table. In 1982, an early frost reduced yields and quality dramatically and yet average prices were only 18¢/lb - the worst possible combination for the producer of low yields and low prices. This year, of course, the exact opposite situation prevails with average yields probably 2½ times what they were in 1982, and prices already more than double. These extreme swings in production and price, underline two important things - one, that bean production is not for the fainthearted, and two, that a bean producer should be in it for the long term, not the short term.

Before leaving the subject of price it should be noted that in the 9 years since 1978 bean producers lost money in three years (including 1985), but made more than $100/ac in four years. A good case can be made for a price stabilization program when prices can swing by 300% in five years!

3. Producing Beans

Table 4 gives an indication of the yield potential of beans.

Table 4

Manitoba Pulse Growers Association/Agri-Food - Bean Trial 1986

Seeded May 30 Cut September 16

		kg/ha	% of Seaforth
Pinto	Topaz	3316	150
	D81122	3063	138
Red Mexican	ISB-480	3228	146
Navy	D80024	2935	132
	D84071	2934	132
	Harrowfleet	2814	127
	Exrico 23	2746	124
	ISB-1	2372	107
	OAC Seaforth	2217	100
	Opal	2153	97
	Admiral	2105	95
	D76125	1952	88
	D79054	1941	88
	D82339	1800	82
Dk. Red Kidney	82866	2888	131
	D83353	2834	128
	82960	2065	93
	D81183	1508	68

This trial was run by the Manitoba Pulse Growers Association under an Agri-Food program and is scheduled to continue in 1987. The yields are excellent but it is worth noting that commercial white bean yields well over 2000 lbs/ac were harvested in 1986.

Most of the new introductions in this trial were from Idaho, where both the university and private breeding programs are developing some interesting new lines. The Ontario bean program also continues to produce excellent varieties.

Field beans are the third grain legume of importance in Manitoba behind field peas and lentils. The area of 6500 hectares compares with 64,000 for peas and 26,000 for lentils. The modest acreage in production at present could expand considerably from a soil and climate standpoint.

The 1986 production will be a record; however, beans are extremely vulnerable to major swings in price; and over-production leading to very low prices is a distinct possibility.

The bean plant is leafy and grows rapidly following emergence from a warm seedbed. As a legume, protein content of plant and eventually seed is high. Inoculation of the seed or soil with the specific Rhizobium inoculant is recommended and generally practiced in Manitoba. However, field beans are notoriously erratic nodulators and many producers add from 40 to 60 lbs actual N per acre. Excellent crop development is the result so long as other nutrients are not limiting. Some experienced bean producers are applying sulphur, potassium and zinc, as well as phosphate each year to their bean crops.

Excessive vegetative growth can lead to disease problems. Clean seed, guaranteed free from bacterial blight is essential. To protect from white mould, chemical applications must be used, and under heavy growth, as in 1986, sclerotinia thrives in the moist microclimate. Expensive benomyl treatments (up to $67/hectare per application) are increasingly common with bean producers.

For weeds the available chemicals provide excellent control - trifluralin pre-plant, Basagran for the broad leaf weeds post-emergent (specially wild mustard), and Poast for any volunteer grains or trifluralin escapes.

At harvest time the array of machinery in the field is another reminder of the capital cost involved in producing beans. A bean puller or cutter gently slices the plants at ground level, followed behind the tractor, or as a separate operation, by the windrower. Once the windrows are dry (around 16 - 18% m.c.) combining begins. It is essential that beans not be too dry, or excessive splitting will result.

A Lilliston bean combine separates beans gently from pods. Rotary combines are also used and are faster but do more damage. Some producers have modified conventional combines successfully, dropping cylinder speeds to around 150 r.p.m. to reduce splitting and cracking.

Inside the bean combine, pods are shredded rather than threshed and seed is elevated into the tank rather than augered. The entire tank is hydraulically emptied when full, again to prevent augering and therefore splitting. At the cleaning plant, conveyors and elevators are used to unload the beans. The same careful treatment is given to all beans - whites, pintos, dark red kidneys, etc.

Finally beans are cleaned, another operation requiring investment in expensive machinery such as gravity tables and electric eye sorting machines (for white beans), so that a product which can compete in the domestic and export market is produced.

4. Production Costs

Operating costs are much higher with beans compared to wheat.

Table 5

Costs of Production ($/hectare)

	1986	
Operating	Wheat	Beans
Seed & Treatment	18.52	62.99
Fertilizer N	43.23	17.29
Other	23.47	44.46
Inoculum	-	2.47
Chemicals herbicide	45.70	86.45
fungicide	-	66.69
Fuel	27.17	34.58
Mach. operating	17.29	32.11
Insurance	15.19	34.58
Miscellaneous	14.82	17.29
Drying	-	2.47
Int. on operating	12.28	18.53
Total Operating	$217.66	$419.90
Fixed		
Land	111.15	111.15
Machinery depreciation	35.07	46.68
Machinery investment	29.15	37.30
Storage	7.41	9.88
Lab. and management	39.52	49.40
Total Fixed	$222.30	$254.41
Total Costs	$439.96	$674.31

Seed, chemicals, machinery and insurance are the big ticket items. However, computing a breakeven price of yield for beans vs wheat makes beans look good even at the relatively modest price level of 44¢/kg or yield of 1450 kg/ha

Table 6

Breakeven Budget for Beans vs. Wheat

Breakeven

1. Beans

On operating costs at 44¢/kg (20¢/lb): 954 kg/ha Yield (850 lb/ac)
($419.90/ha)
at 1450 kg/ha (1290 lb/ac): 29¢/kg Price (13¢/lb)

On total costs at 44¢/kg (20¢/lb): 1532 kg/ha Yield (1365 lb/ac)
($674.31)
at 1450 kg/ha (1290 lb/ac): 47¢/kg Price (21¢/lb)

2. Wheat

On operating costs at 11¢/kg ($3/bu): 1979 kg/ha Yield (29 bu/ac)
($217.66/ha)

at 2695 kg/ha (40 bu/ac): 8.1¢/kg Price
($2.20/bu)

On total costs at 11¢/kg ($3/bu): 3400 kg/ha Yield
($439.96/ha) (59 bu/ac)

at 2695 kg/ha (40 bu/ac): 16.33¢/kg Price
($4.45/bu)

11¢/kg ($3/bu) is not an exciting prospect as an initial price on #1 HRS wheat for 1987; at that price, to break even on total costs would require a yield of 3400 kg/ha (59 bu/ac) of wheat. The breakeven yield of 1532 kg/ha (1365 lbs/ac) of beans is probably more readily attained.

At the present time, therefore, beans look good in Manitoba, not only based on current prices but also future prospects. The price of beans is not determined in Manitoba and producers will continue to live with the combination of higher risk and higher potential return. For those who will pay careful attention to management detail; will be patient in marketing (with ability to store on-farm); and will stay with the crop, there will probably be significant rewards.

Manitoba's acreage could perhaps double or triple in time to more than 20,000 hectares without significantly influencing the current balance of supply and demand. Beans are a valuable crop which provide another cropping option and fit well into cereal rotations.

In planning for another crop year, however, producers would do well to remember that farmers in Ontario, Michigan and North Dakota are also looking for alternatives. The potential for too many beans is very real - it nearly happened in 1986.

OUTLOOK FOR FORAGE SEED PRODUCTION

Manitoba is a large producer of forage seed and as far as I can see, will continue to do so for many years to come.

During the next 20 minutes, I will try to analyze the "Outlook for Forage Seed Production" for Manitoba's Producers. Covering our major forage seed crops such as Timothy, Alfalfa, Sweet Clover and Red Clover; we will look at future markets, prices and worldwide trends.

Alfalfa has been grown for seed in Manitoba for years, but not until the last 20 years has the management been developed to produce consistant crops, year after year. The past ten years have turned Manitoba from an importer, to self-suffiency, and finally to a net exporter of Alfalfa.

Manitoba Alfalfa Producers have many advantages over their American counterparts. The land Manitobans produce seed on, does not have the tremendous values that the American land has; and the exchange rates with our dollar make it favourable for the Americans and other countries to import Manitoba's seed. American production costs are much higher. The American Alfalfa Producers generally manage their crops much more extensively than we do in Manitoba. Through large usage of pesticides, herbicides and in some cases, irrigation, their expenses to produce Alfalfa seed is driven to much higher levels than what our costs are in Manitoba.

Manitobas Alfalfa Seed Producers are no longer producing only Common and Canadian Certified Seed, but are producing varieties for export under multiplication contracts with seed companies from the United States and Overseas.

I think these markets can hold for some time. If Alfalfa seed becomes much lower priced than it is today, American growers could not afford to grow it because of their extremely high operating costs.

There is one major problem that could hurt the whole Alfalfa seed business in the near future. Recently, it was announced that several million acres eligible for Alfalfa in the American Conservation Program, were also eligible for seed production. I do not think this will have much of an effect for the 1987 and 1988 crops, but watch out for 1989. By this time, many Mid-west acres could be producing millions of pounds of Alfalfa seed.

For the future, I think Alfalfa seed should be good.

Timothy production in 1986 was what I considered a fair crop. Not good, not poor. The 1985 crop produced about one half the seed that was there, due to the wet weather during the harvesting period. Total production for 1985 and 1986 was about the same, and any stocks in the trades or farmers hands from the last two years or previous are now all cleaned up. The pipelines to both Overseas and North American markets are also pretty much empty.

So far, I would say things look pretty bright for prices and production of Timothy. But, there is a traditional problem with Timothy. THE PRICE OF WHEAT DIRECTLY REFLECTS THE AMOUNT OF FOUNDATION CLIMAX TIMOTHY SEED RELEASED TO FARMERS THROUGH THE FORAGE SEED PROJECT. When the price of wheat goes down, Timothy acreage goes up and the price eventually falls. The producers that make real good money at Timothy are the ones that stay in it. Good years and bad, they hit all the prices and things tend to even up.

Whether we like it or not, all varieties, should they be Japanese, American, Canadian, ore produced for E.E.C., are fixed to the price of Climax Timothy. Some pay more, some pay less.

Seed trade companies generally put in only as much Timothy as they think is marketable for the crop years grown. To carry over surpluses is certainly a sin unless taking market positions.

I have cautious optimism for Timothy. If producers and trade stuck together increasing acreage cautiously, and growing varieties for export, I can see Timothy holding up well. If acreages go up overnight, the bottom could fall out.

There are approximately 23,000 lbs. of Foundation Climax released to growers and the trade in 1986. At a seeding rate of 2 lbs./acre, you get 11,500 acres seeded and at a failure rate of 30%, your total new acreage for 1987 is 8,050 acres. This ismore than double the rate of the last 5 years. We can only hope that other grasses are not available for the U.S. Conservation Program and the excess Timothy produced will fill the gap. If this does not happen, we could see a large surplus overnight.

Markets for Sweet Clover and Red Clover have been extremely active since the initiation of the P-I-K Program, two years ago in the United States. Prices are now at all time high.

Sweet Clover acreage is down in Manitoba due to late, wet Springs we have had the last two years. The clover usually thought of as a secondary priority has not been seeded due to the rushed seeding periods.

For the 1987 crop, I expect that Sweet Clover acreages will be down again and markets should be good.

The Red Clover acreage should be up because of producers keeping their fields for extended periods due to the good markets. Acreages seeded in the Spring of 1987, should be extremely high, so I would be very cautious for 1988. But, if the American Conservation Program takes on as Many acres as some predict, the market could easily handle as much Sweet and Red Clover as we could possible produce.

With the outlook good for most forage seeds for the next year, I think it is time we looked at the long term usage of forage seed throughout the world.

Europeans, no doubt the most advanced farmers in the world today, (because of large subsidies) are now looking at putting in more and more forage crops to improve their land.

In Norway and Sweden, governments are starting to put large taxes on pesticides, herbicides, and even fertilizers. They are influencing producers to plant trees on erodible land.

This also has to do with the huge subsidies that the people can no longer afford to pay these producers. Most E.E.C. nations have long term plans to increase forage use to improve their land for future generations.

China uses at least 10 million hectres of plow down forage/year and seed 1.5 million hectres for land reclamation each year.

Attitudes of people all over the world are changing. People are no longer putting up with polution from factories, sewage dumpings in lakes, rivers, and oceans.

This is going to affect farming in a tremendous way. We are already seeing the start of it in Europe. The general population is going to dictate how farmers manage their farms.

As we have seen in the United States, farmers have been forced to join the Conservation Program in order to get guaranteed prices for their products. Not only have the farmers had pressure put on them by being offered these high prices, but banks have also forced producers to join the program.

Extremely powerful lobbying groups work extremely hard toward putting land "back to nature" in the United States and Canada. One of the major groups in this is Ducks Unlimited.

We have seen them hold up land openings in Manitoba. The first I can think of, is The Pas, where they control about 200,000 acres of prime land. This, of course, done through lobbying our provincial and federal governments. Basically, the conservation groups have worked harder and have more money to lobby the governments than the farmers have; and consequently, the farmers will lose future battles.

Forages will play a great role in this. In the future, producers are not going to be continously croping for 10 and 20 years like they do today. They do not in Europe and shortly they will not be in the United States and Canada.

Does the future look bright for Manitoba Forage Seed Producers? It certainly does.

THE ECONOMIC BENEFITS OF FERTILIZING FORAGES

J. Ewanek
Manitoba Agriculture

The production of forage hay is a major part of the overall agriculture industry in Manitoba. Over nine hundred thousand hectares of the land base are in tame forage production. The majority of this forage is consumed by the large cattle population in the Province. Unlike with annual crop production, the economic opportunities of fertilizer use have never been widely picked up in the production of forage crops. On most farms, it is difficult to measure the economic benefits of fertilizing forages because the product is not sold directly for a price but marketed indirectly through a cattle herd. The economic benefits do tend to become more apparent in years of production shortages when producers are forced to buy hay.

Forage agronomists have, for the last three decades, shown the production (yield) benefits of applying fertilizer to forage crops (Table 1). However, during this time, the fertilizer demonstrations have failed to convince forage producers to fertilize anywhere near the extent that is observed in the production of annual cash crops. Maybe part of the explanation lies in that the benefits were usually shown on the yield rather than economic side of the equation. Another part of the explanation could also be that some of the reported responses to fertilizer were somewhat marginal. The average yield response of the 31 demonstration sites in 1957 (Table 1) was a marginal 1.1 tonne/ha. The net return from fertilizer was also marginal at $5/ha in 1957 and $30/ha in 1986 dollars. However, studying the range in yields and returns, the upper end looks very favorable at 2 tonnes/ha or $22 and $78 per ha in terms of 1957 and 1986 respectively. (The price basis for 1986 was $50 per tonne of forage and $0.61 per kilogram of P_2O_5.) The upper range illustrates that very favorable economic returns are possible by using fertilizer on forage crops; however, all aspects of forage crop management must be in place to achieve the necessary yields.

Fertilizer use has not been widely accepted by forage producers (Table 2). Manitoba Crop Insurance Corporation on Questionnaires report that only 20 to 24 percent of alfalfa lands are fertilized annually. Their statistics show little change in the past 12 years. During the same time, over 90 percent of the wheat and barley stubble acreage was fertilized. The crop insurance statistics lean toward producers whose main crops are annual cash crops. In a recent Beef/Forage Producers Survey, 48 to 57 percent of the producers stated that they fertilize their forages annually. An extension staff estimate is 40 percent.

The economic benefits of applying fertilizer to forage crops on a provincial, research and demonstration basis is presented in Table 3, 4, and 5 respectively. On a provincial basis (Table 3), as reported on the Crop Insurance Questionnaire, the 1973-1985 average alfalfa yield response to fertilizer was 0.9 tonnes per hectare. Based on a minimum general recommendation for the province of 45 kg P_2O_5/ha, the economic benefit to fertilizer in terms of 1986 prices is equivalent to a marginal $18/ha. (However, most forage producers who use fertilizer probably apply somewhat less than the above minimum recommendation.) Small plot research results (Table 4) provide an estimate of the potential economic benefits of fertilizer with high-tech forage management. On sandy soils, the average annual economic benefit was a very substantial $197 per hectare (in terms of 1986 prices). The research statistics which are probably more important to cattlemen relate to yield and quality, 7.2 tonnes per hectare at 22 to 24 percent protein on the fertilized treatment as compared to 1.8 tonnes per hectare at 10 to 11 percent protein on the non-fertilized. Economic benefits of fertilizer as well as economic losses were demonstrated in a large plot fertilizer demonstration in the Ste. Rose district (Table 5). Good three-year dollar returns were reported to both the dealer and provincial soil test lab recommendations on the Fillion farm. However, on the Sigurdson farm, a good return was reported only to the provincial soil test recommendation. On this site, the net result of the dealer recommendation was a slight loss of monies. These results illustrate that profitable forage fertilizer management should start with a soil test and recommendations based on local research.

A question asked by many producers is 'Does the application of phosphorous fertilizer to forage crops pay?' Years of demonstrations by extension staff as well as in many cases having themselves tried applying phosphate fertilizer has failed to convince many individual producers of the benefits. This is unfortunate because Manitoba soils are low to medium in available phosphate and therefore the probability of a response is very good. The data in Table 6 shows that a good economic response can be expected to phosphate fertilizer in Manitoba on deficient soils. The site on the Glenmoor soil is a noteworthy example. The co-operator was Les Kurbis, the president of the Eastern Grassland Society. He had an excellent stand and yields that were acceptable without fertilizer. However, he was very surprised that the application of phosphate increased yields from 4.2 to 7.0 tonnes per ha for a dollar benefit of $111 per ha. His remarks were, 'I just couldn't believe it, I guess I was one of those guys that had to be convinced about the merits of fertilizing forages'.

The data in Table 7 clearly illustrates the large economic benefits of applying a particular nutrient when it is the chief limiting factor in production. In these examples, without sulphur fertilizer, the addition of phosphate had a minimal effect. By adding a small amount of sulphur, the three examples on Table 7 showed in a very substantial return for the dollars invested in fertilizer. Another nutrient which is commonly the limiting factor on sandy soils and also results in very substantial returns when applied is potassium.

Stuartburn - Piney Agricultural Development Association used a different approach in assessing the economic benefits of fertilizers (Table 8). Rather than looking at a somewhat theoretical net return they calculated the economic benefits on a cost per tonne basis, incorporating into the total costs, the fertilizer, operating, and fixed costs. This would appear to be more applicable to most forage producers who feed rather than sell their hay. It also illustrates the fact that by using fertilizer it generally costs less to produce the hay than to buy it.

The economic benefits of fertilizing forage crops are difficult to measure because forages are usually fed on farms where they are produced. Production of the forages is only half of the enterprise, the first half which does not result in a direct cash return. Maybe one approach when talking to cattlemen on the benefits of fertilizer is to point out that it generally costs less to produce feed than to buy it. Good management which includes fertilizer reduces the costs per unit of forage produced, increases the quality, and helps insure a necessary supply is on hand at the farm.

Table 1.

Response Of Grass - Alfalfa To Fertilizer - 1957

Number of sites	31
Rate of 11-48-0 applied	139 kg/ha
Average yield response to applied fertilizer	1.1 tonnes/ha
Dollar value of response (1957)	$22/ha
Cost of fertilizer (1957)	$17/ha
Net return (1957)	$ 5/ha
(1986)	$30/ha
Range of yield responsas to applied fertilizer	0.2-2.0 tonnes/ha
Range in value of yield responses to applied fertilizer (1957)	$13 to $22/ha
(1986)	$27 to $78/ha

Based on data presented by Cranston, C.C., 1957. Demonstration Fertilizer Trials on Grass, Legumes, and Grass-Legume Mixtures. Province of Manitoba Soceity of Soil Science.

Table 2.

Fertilizer Use On Forage Crops

A) Manitoba Crop Insurance Corporation Crop Questionnaire:	
- alfalfa lands fertilized annually	20-24%
B) Beef/Forage Producers Survey:	
- producers who fertilize annually	48-57%
- producers who fertilize to soil test	20-29%
C) Extension Staff Extimate:	
- producers who fertilize annually	40%

Table 3.

1973-85 Provincial Alfalfa Yields As Reported In The Manitoba Crop Insurance Corporation Yield Questionnaires

Fertilized Yields	4.8 tonnes/ha
Unfertilized Yields	3.9 tonnes/ha
Economic Benefits To Applied Fertilizer*	$18/ha

*Based on a minimum recommendation of 45 kg P_2O_5/ha.

Table 4.

Alfalfa - Fertilizer Research

	tonnes/ha	$/ha	% protein
Fertilized	7.2	360	22-24
Unfertilized	1.8	90	10-11
Difference		270	
Fertilizer Cost		73	
Economic Benefit		197	

Note: i) 5 station years on sandy textured soils
ii) 2 cuts per year

Based on data presented by Bailey, L.D., 1983. Fertilizing Alfalfa Forage. Manitoba Agriculture Farm Facts.

Table 5.

1983-85 Ste. Rose District Fertilizer Demonstrations On Alfalfa (4 hectare plots)

	3 Year Totals/Plot			
Treatment	Yield*	$ Value Of Yield	Fertilizer Cost $	Net $ Benefit Of Fertilizer Application
Co-operator: E. Fillion:				
Provincial Soil Test Lab	156	3900	777	1573
Dealer	189	4725	1253	1922
Check	62	1550	-	
Co-operator: G. Sigurdson:				
Provincial Soil Test Lab	153	3825	487	838
Dealer	156	3900	1428	-28
Check	100	2500	-	

*500 kg bales Value of hay @ $25 per bale.

Table 6.

Response Of Forage Crops To Phosphate Fertilizers

Soil		Soil Phosphorus Level	Yield tonnes/ha		$ Benefits Of Phosphate Application/ha
			Check	Fertilized	
Miniota	(1)	medium	3.4	5.1	24
Gilbert	(1)	very low	2.2	4.5	98
Lundar	(1)	very low	1.1	4.9	171
Poppleton	(1)	very low	1.4	5.0	99
Balmoral	(1)	very low	3.0	5.7	118
Inwood	(1)	low	3.0	4.0	38
Osborne	(1)	very low	2.6	3.7	38
Osborne	(1)	very low	2.6	3.4	23
Glenmoor	(2)	very low	4.2	7.0	111
Erickson	(3)	low	2.5	3.7	22
Caliento	(3)	high	3.5	4.3	-1

(1) Based on data presented by Soper, R.J., 1961, 1962, 1966, 1968. Effect of Fertilizer on Forage. Province Manitoba Society of Soil Science.

(2) 1985/86 Eastern Grassland Society fertilizer demonstrations.

(3) 1981/82 Manitoba Agriculture fertilizer demonstrations.

Table 7.

Alfalfa - Sulphur Demonstrations At St. Alphonse - Bruxelles 1984-85

Co-operator	Soil Sulphur Level	Yield (tonnes/hectare) No Fertilizer	Yield (tonnes/hectare) 55 kg P_2O_5/ha	Yield (tonnes/hectare) 55 kg P_2O_5 + 33 kg S/ha	$ Benefit Of Sulphur Fertilizer/ha
G. Tack	medium	1.2	1.8	5.6	179
R. Tack	low	3.1	3.9	4.8	34
R. Delorme	low	2.6	3.7	6.1	112

Manitoba Agriculture fertilizer demonstrations.

Table 8.

1986 Cost Of Fertilizing Alfalfa Demonstration
Stuartburn-Piney Agricultural Development Association

Rate	Fertilizer Type	2 Cut Yield* Tonnes/hectare	Fertilizer Costs $/hectare	Operating Costs $/hectare	Fixed Costs $/hectare	Cost Per Tonne $
0	-	1.3	0	16.60	61.75	60.27
56	6-28-28	2.9	14.87	17.73	61.75	32.53
111	6-28-28	4.4	29.71	20.87	61.75	25.52
167	6-28-28	5.4	44.56	22.38	61.75	23.83
222**	6-28-28	7.0	59.43	24.43	61.75	20.80
276	6-28-28	7.1	74.22	24.55	61.75	22.60
392	6-28-28	7.1	103.94	24.55	61.75	26.79
111	0-0-0-90	1.2	38.68	16.45	61.75	97.40
111	0-0-60	1.3	16.25	16.67	61.75	72.82
111	11-55-0	5.6	39.25	22.53	61.75	22.05
0	-	1.1	0	16.30	61.75	70.95

* Only second cut was taken, yields used in calculation are based on multiplying the second cut yields by a factor of 2.

** Provincial soil test recommendation.

Forage Beef Extension

Gil Lahaie
Chief, Agro-Land Planning and Management
Agricultural Crown Lands Branch
MANITOBA AGRICULTURE

Forage production and livestock production are frequently perceived as very distinct and separate farm enterprises. In fact, the two are basic components in a complex industry in which unmarketable roughages are produced and converted into marketable livestock products. This is particularly true in the case of beef products, where 98% of the birth to slaughter ration of the finished beef animal has consisted of roughages.

It is important that this relationship be recognized and stressed in technology transfer efforts. The forage-beef approach demonstrated under the Canada-Manitoba Agro-Man and Agri-Food Programs, as well as the Grassland Societies Program are good examples of the integrated extension required.

Manitoba Agriculture is currently investigating avenues for closer integration of its forage and beef extension programs. A Departmental Task Group was established in the spring of 1986 to initially evaluate existing extension programs in Manitoba related to beef and forage productions; and subsequently develop an integrated beef/forage management extension program and delivery strategy. Members of the Task Group include Dr. Frank Baker, Director, Animal Industry Branch; John McKinnon, then Chief, Beef Section, Animal Industry, Dave Campbell, Chief, Grassland Section, Soils and Crops Branch; Gerry Therrien, Chief, Farm Management Section; Fraser Stewart, Regional Grassland Specialist, Beausejour, and myself.

Some of the more specific areas the Group was asked to concentrate on in the review included:

- the level of adoption of production technology among Manitoba beef producers;
- if this level is lower than other enterprises, what are the reasons;
- which technologies are adopted first and why;
- what are the constraints to the adoption of new technology;
- evaluate the effectiveness of existing programs;
- development of a profile of clients and client needs;

What I would like to do today on behalf of the Task Group, is discuss some of the observations from our first phase.

PROFILE OF MANITOBA BEEF PRODUCERS

The Group relied heavily on 1981 Census data to define the characteristics of Manitoba Beef producers. Although the industry has undergone some changes since 1981, the data is still pertinent in terms of general trends. Some highlights of the profile are:

1. With respect to cow-calf operations, the average herd size in 1981 was 32 cows.

TABLE II-BEEF MANAGEMENT-PRODUCER PERCEPTION OF IMPORTANCE & ADOPTION

	IMPORTANCE*	% of respondents utilizing practice
Strive to maintain cows on a yearly calving interval	3.7	93
Vaccination	3.6	86
Castrate as calves	3.5	90
Warble Fly Control	3.5	77
Use Herd Size Evaluation	3.5	59
Breed heifers to calf as 2 year olds	3.4	84
Fly Control	3.3	77
Cull open cows prior to calving season	3.3	73
Dehorn as calves	3.1	59
Keep records on financial & production aspects of the herd	3.1	53
Follow a cross-breeding program	3.0	66
Pregnancy checking	3.0	44
Use growth implants	2.5	40
Use yearling bulls for breeding	2.4	49
Practice heat synchronization	1.4	4

* 4=Very Important, 3=Important, 2=Somewhat Important, 1=Not Important

The results show the expected and logical correlation between producer perception of the economic importance of individual practices, and the utilization of these practices. Highly rated practices are generally highly utilized.

However, even though producers indicate that they will utilize practices in which they can see economic benefits, it also appears that benefits must be either immediate, direct, or visible before they adopt it. For example, practices such as annual fertilization of forages, herd size evaluation, herd record keeping are rated as being of some importance but are not widely utilized.

It also appears that producers perceive the beef management aspects of their operations to be generally more important than the forage aspects.

In addition, in both areas, there was a trend indicating a higher perception of importance, and greater utilization of technology with increasing size of herd.

EFFECTIVENESS OF VARIOUS SOURCES OF INFORMATION

Producers were also asked to rate various extension methods as to their effectiveness in providing them with information and the results are outlined in Table III.

According to this data, producers rate newspaper articles and Departmental contacts as good sources of information.

Larger size operations generally place greater importance on all sources of information than do smaller ones.

This information correlates well with earlier findings by Dr. Don Blackburn, of Guelph in which contact with extension staff, as well as

TABLE III-PRODUCER OPINION ON EFFECTIVENESS OF EXTENSION MEETINGS

		SEGREGATED BY HERD SIZE		
METHOD	ALL PRODUCERS	(50 cows;	50-100 cows)	100 cows
Newspaper Articles	3.02	2.99	3.00	3.16
Technician Consultation	2.98	2.92	2.94	2.94
Ag. Rep. Consultation	2.95	2.94	2.93	3.06
Specialist Consultation	2.93	2.89	2.85	3.32
Newsletter	2.86	2.80	2.77	2.89
Fact Sheet Pamphlets	2.80	2.80	2.77	2.89
Ag. Office Visit	2.78	2.75	2.83	2.75
Farm Meetings	2.71	2.60	2.82	2.75
On Farm Demonstrations	2.70	2.65	2.71	2.83
Regional Demonstrations	2.63	2.53	2.71	2.75
Tours, Field Days	2.62	2.60	2.47	3.16
Home Study Courses	2.46	2.50	2.37	2.59
Video Cassettes	1.94	1.85	2.00	2.05
Grassroots (Telidon)	1.85	1.81	1.83	2.06
AVERAGE RATING	2.65	2.60	2.65	2.83

4 = Very Effective, 1 = Not Effective.

written materials such as publications, newsletters and factsheets rated high as effective information sources.

FURTHER OBSERVATIONS

The information presented in this paper and especially the producer opinions and views are only a small sample of the Task Group's findings. Based on this data, it would appear that extension efforts will need to recognize the diversity in the composition of Manitoba's beef industry, including the fact that 60% of beef operations are secondary to another enterprise on the farm; and the implications of being secondary in the adoption and application of technology to the beef enterprise. As well, the significant amount of off-farm employment has implications not necessarily to adoption of technology, but in the effectiveness of extension methods such as day-time winter farm meetings, to name one.

In extension efforts, the short and long term, direct and indirect economic benefits of technology need to be clearly identified if producers are to adopt technology.

The fact that forage management is generally perceived to be of lower economic significance that livestock management points out that there is a great need for integration of forage and beef extension efforts. Regardless of the ideal genetic make-up of the herd, regardless of the best herd health program, and, regardless of the best livestock husbandry practices, beef can't be produced without forage.

2. The majority, or 78% of the 1981 cow-calf producers had herds of less than 48 cows and accounted for only 44% of the provincial cow herd.

   Conversely, the minority, 22%, operated herds of 48 cows or more, and accounted for 56% of the provincial herd.

3. Of farms with sales over $2500 and reporting an involvement with beef, beef production was the main enterprise on 38% of these farms and 57% of the provincial beef population was found on these farms.

4. The majority or 59% of cattle producers were 49 years or older, with 18% being 60 years or older.

5. Thirty-two percent (32%) of cattle producers with sales over $2500 in 1981 reported an average of 147 days per year off-farm employment.

   Ten years earlier, 21% of producers had reported an average of 114 days per year.

These, and other indicators of the composition of the industry must be considered in the development of extension programs.

PRODUCER PERCEPTION AND ADOPTION OF TECHNOLOGY

To gain insight on the general level of adoption of forage and beef management technology, the Group surveyed 1000 Manitoba Beef Commission enrollees via mailed questionnaire. Three hundred and twenty-six (326) responses were received.

This survey generated very interesting information. For example, producers were asked how they viewed the importance of certain management practices to the profitability of their forage programs; and whether they were utilizing these practices on a regular basis:

TABLE I-FORAGE MANAGEMENT-PRODUCER PERCEPTION OF IMPORTANCE, & ADOPTION

	IMPORTANCE*	% of respondents utilizing practice
Use recommended varieties	3.3	74
Innoculate legumes	3.2	71
Include Forage as Part of a Crop Rotation	3.1	69
Fertilize annually	3.1	51
Use rotational grazing	3.0	72
Keep records on the cost and production aspects of forages	2.7	30
Fertilize to soil test	2.7	23

* 4= Very Important, 3= Important, 2= Somewhat Important, 1= Not Important.

Similar questions were asked with respect to beef production technology.

HIGH YIELD ALFALFA CLUB - FARM SCALE

by

Charles J. Horvath, Landmark Agro
Steinbach , Manitoba

A. INTRODUCTION

I shall begin with giving you a short history of how our High Yield Club got organized, also why, and what it has done in the way of accomplishments.

Several alfalfa growers approached me on an individual basis at first, basically asking questions about how our High Yield Wheat Club was doing, which had been very actively functioning for approximately three years already. This inspired me to the point where we suggested to these growers, why should we not have a High Yield Alfalfa Club. It was approximately two years ago when we invited nine of our more progressive alfalfa growers to an organizational meeting, eight of them attended.

B. FARMERS OBJECTIVES

1) Increase Yields
2) Improved Feed Value
    a. T.D.N.
    b. Protein
3) Profitabity

Why have we gathered together, I asked? Three very basic reasons were brought forward by the group;

i) They were all interested in how they could increase their yields.
ii) Coupled together with higher yields they wanted to produce higher quality feed.
iii) Together with achieving the first two goals, they felt it was very inportant that the end result be that they make more money.

C. PROCEDURES

1) Size 8 hectares min.
2) Goals
    - club
    - individual
3) Field Record
    - field history
    - rainfall
    - variety
    - soil test
    - fertility program
    - pesticides

4) Costs Allocation
   - fertilizer
   - seed
   - field work
   - fixed costs

Getting into what we have done thus far towards accomplishing the above mentioned objectives; alot of time has been spent by both the growers and ourselves trying to establish what procedures we will use to measure and compile data. We than agreed that;

i) A club field shall not be less than 8 ha. in size.
ii) A realistic, yet challenging target goal, must be set but it is not compulsory to shoot for it.
iii) Variety shall be given, along with any mixtures if such needed.
iv) The club field must be soil tested at least once a year. (They must all be done at the same lab or split between two labs.)
v) A complete history record of the field must be kept.
vi) A complete record of rainfall must be kept from April 1st to September 30th. (Also recording dates and amounts of each measurable precipitation.)
vii) A complete summary of the fertility program. (Dates, amounts, method of application, and total cost.)
viii) Recording pesticide program if needed.
ix) Seed cost per ha. amortized over 4 years.
x) Field work per cut (same figure for each grower).
xi) Fixed cost to be the same for each grower.

D. SAMPLING

- 3 X 1 square metre samples
- weighed - % moisture
- results given in TONNES PER ACRE
- feed analysis - U. of M.
  - crude protein
  - crude fibre
  - total digestable nutrients

Now we are at the point where we have to measure and monitor to get the sought after data. We are to take three separate 1 sq. metre samples at random from each club field before each cut. These are then individually dried down, weighed, and analyzed for:

1) Crude Protein
2) Crude Fibre %
3) Acid Detergent Fibre %
4) Est. T.D.N. %

Plant tissue samples are also taken at this time and submitted to a lab for a complete plant analysis.

E. FERTILITY PROGRAM

- All liquid & Micro-nutrients
- All dry & Mico-nutrients
- Fall vs Spring
- Split application

The grower has had to make a number of management decisions by now. He had to decide on a fertility program based on his soil test results for his targeted goal. This could be a difficult one, for together we may have run a ;

i) Complete liquid program, including micro-nutrients, surface strip banded.
ii) We may also have run a complete dry blend with micro-nutrients, broadcast.
iii) He may have chosen not to include the fairly costly micro-nutrients at all.
iv) He may have chosen to fertilizer in the fall instead of early spring.
v) He may also decide to split-apply, such as 60% of requirements applied in the fall, and 40% applied after 1st cut.
vi) Un-ending variations of the above.

F. SUMMARY

Already we can see how interesting it will be to compare the results one grower got versus seven others, in field size plots, and everything carried out according to general management principals. These eight growers all situated in a approximate radius of 40 km of Steinbach, some east, west, north, and south, also in varying soil types, with of course varying amounts of rainfall, which is carefully monitored right at the end of the field in most cases.

Now let us look at what we had agreed we needed to record and monitor.

1984 - 1985

	LOWEST	HIGHEST
HECTARES	8	26
FERT. COST/ HA.	45.83	135.58
PESTICIDE COST/ HA.	0.00	0.00
SEED COST / HA.	5.48	5.48
FIELD WORK / HA.	46.88	73.75
FIXED COST / HA.	125.00	125.00
COST OF PRODUCTION	223.19	339.81
YIELD (TONNES)	5.702	9.755
GROSS PROFIT / HA.	427.65	731.63
NET PROFIT / HA.	204.46	391.82
BREAKEVEN YIELD	2.975	4.530
COST / TONNE	39.14	34.83

	985 - 1986	
NAME	LOWEST	HIGHEST
HECTARES	9.6	28
FERT. COST/HA	84.15	213.62
PESTICDE COST/HA	0.00	0.00
SEED COST/HA	15.62	15.62
FIELD WORK/HA	181.25	276.25
FIXED COST/HA	125.00	125.00
COST OF PRODUCTION	406.02	630.49
YIELD (TONNE) / HA	6.757	11.107
GROSS PROFIT/HA	439.20	721.95
NET PROFIT/HA	33.18	91.45
BREAKEVEN YIELD/HA	6.246	9.699
COST / TONNE	60.09	56.77

Other interesting things to note: In the first year the Club data revealed that the highest yield winner was also the winner of the best economic return, but not the highest amount of tons T.D.N. This year one grower was successful in capturing all three of the awards.

This next over-head will bear out the fact that all variables affect the end result in different ways.

	1984 - 1985	
NAME	WINNER	AVERAGE
HECTARES	16	16.7
FERT. COST/HA	45.83	94.70
PESTICIDE COST/HA	0.00	0.00
SEED COST/HA	5.48	5.48
FIELD WORK/HA	66.87	59.60
FIXED COST/HA	125.00	125.00
COST OF PRODUCTION	243.18	284.78
YIELD (TONNES) / HA	9.755	7.832
GROSS PROFIT/HA	731.63	587.40
NET PROFIT/HA	488.45	302.62
BREAKEVEN YIELD	3.242	3.797
COST / TONNE	24.93	36.36

	1985 - 1986	
NAME	WINNER	AVERAGE
HECTARES	9.6	15.2
FERT. COST/HA	96.13	142.75
PESTICIDE COST/HA	0.00	0.00
SEED COST/HA	15.62	15.62
FIELD WORK/HA	276.25	206.65
FIXED COST	125.00	125.00
COST OF PRODUCTION	513.00	490.02
YIELD (TONNES) / HA	11.108	8.290
GROSS PROFIT/HA	722.02	538.85
NET PROFIT/HA	209.02	48.83
BREAKEVEN YIELD	7.892	7.538
COST / TONNE	46.18	59.11

Where are we going from here? As the Club Members observe and compare the results of the other growers, and look at their achievements, they keep moving forward. "Fine-tuning" is what it is all about said one of the growers at our last regular meeting. They have indicated already that they will be setting their yield goal a little higher this coming year, even though the winner did not quite reach the set goal of five tonnes this year.

G. ACHIEVMENT AWARDS

1) Highest Yield
2) Highest Tons T.D.N.
3) Highest Economic Return
    - fixed cost
    - land cost @ $ 50.00
    - harvesting @ $ 35.00/cut
    - seed cost @ four year average

CANADIAN FORAGE COUNCIL

K.W. Clark
Department of Plant Science
University of Manitoba

Historically, in 1981 the research branch of Canada Agriculture and the Livestock Feed Board of Canada sponsored a national symposium on forage crops and their utilization, with the objective of assembling a body of knowledge for producers, extension workers, scientists and the agriculture industries. They developed a comprehensive document on the state of forage crop production and use in Canada and they identified some of the problems and opportunities facing this vital component of Canada's agriculture for the future. Proposals for action were formulated by the participants and a forage strategy was developed. This kind of action has now been taken up by most of the provinces across Canada, some with considerable success.

In his concluding remarks to the symposium Dr. J.C. St. Pierre, the symposium chairman, summarized as follows:

"During a panel discussion, producers strongly stressed the need for a national association or regional associations, or both, that would bring forage people together and promote forage crops. A Canadian National Association could be modeled on the American Forage and Grassland Council (AFGC).

A Forage Council could act as a catalyst for action in establishing adequate promotion and marketing systems, especially if producers form the main body of the council."

In other words, what appeared to be needed was "a voice for the forage-based industry" Canada-wide. These sentiments were echoed by almost everyone in attendance and from across the country, as most people agreed that the lack of coordination or focus is the industry's most obvious shortcoming. As you can imagine, this of course is much easier said than done when you consider the numbers of groups, crops, regions, etc. that make up the Canadian forage industry. Oftentimes, in terms of export marketing they are competing one with another to the detriment of the overall Canadian agricultural industry.

Members of C.A.S.C. and provincial groups reviewed the Forage Strategy Report and were in basic agreement with its recommendations.

In September 1983, a group representing both levels of government, forage researchers, producers, universities, seed companies, etc. met to determine the viability of setting up a Canadian Forage Council. It was agreed that the organization should be broadly based, to include all aspects of forage production and use, provide practical solutions to producers' problems and needs, increase the use of forage crops in Canada, integrate forage production with animal production, help coordinate existing activities and help preserve Canada's agricultural resources. The group would coordinate existing organizations and efforts and not duplicate or overlap other authorities.

We reviewed the operation of the American Forage and Grassland Council, which has both producer and researcher involvement.

Terms of reference, bylaws, and anticipated budgets were developed as a guide to what might be expected.

It was determined that some interim funding would be required to more fully explore the desirability of establishing a Council, and several organizations were subsequently asked for assistance. From the CSTA, CSGA, SECAN and the Livestock Feed Board of Canada an amount of $17,000 was pledged. Dr. Walter Childers, a retired forage breeder, was engaged on a voluntary basis to make additional contacts and develop the concept further. I might add that very little of the $17,000 has been spent, since most of the services, office expenses, telephone and postal expenses have been volunteered to date.

A further meeting of the expanded group was held in February 1984 at the time of the Canadian Forage Seed Project meeting. It was at this meeting that we looked more seriously at costs, who should be involved, and a mechanism to meet these objectives.

This, then, provides you with the background and the activity to date that has taken place in attempting to develop the concept of the Canadian Forage Council. Since that date Dr. Jack Winch, now retired from the University of Guelph, came on board to help Dr. Childers in developing a brochure, copies of which are at the back of the room, and to help in getting the message to producer groups and the industry as a whole.

For such a group to be viable, input and involvement from all segments of the forage industry is needed, and national priorities have to be struck based on the needs of the regions of Canada and the groups who are to take advantage of such an organization.

While some preliminary work has been done and every effort made to consult with interested and affected organizations, there is nothing fixed or final. We thought we had to start somewhere and do some background work in order to bring the matter to this stage of discussions, but I want you to know that the process is really just beginning and your contribution is absolutely essential if we are ever going to accomplish the goal of establishing a Forage Council.

As I see it there are three major issues to be addressed by Manitoba agronomists; together with other views, a concrete proposal should be developed and presented to Agriculture Canada, the provinces and the industry for approval and implementation.

For the purposes of discussion, you may wish to begin by looking at these three major questions.

1. Is there really a need for the Canadian Forage Council and if so what would the organization do to promote your interests in forage?

2. Who should be involved and what is the best way to ensure maximum participation and effectiveness of individuals and interested groups?

3. How should such an organization be structured and financed?

If there are some general questions which you would like addressed, some of us here who have been involved so far will be pleased to try to answer them. Mr. Dave Campbell, Chief - Grassland Section M.D.A. is the flag bearer for M.D.A.

I should like to now point out a few of the facts noted in this introductory brochure and then mention some of the activities that the American Forage and Grassland Council have been involved in during the 1980's.

Forage crops are Canada's #1 crop; with an estimated 50 million acres of hay and pasture across Canada it is by far the largest crop. The hay crop alone has an estimated value of more than $1 billion.

Forages provide up to 65% of the feed for dairy operations and up to 100% in beef and sheep production. High quality hay or silage has become the basic ration for all milking herds. Of the 50 million acres of forage, only 11 million have been improved and less than half contain legumes. Less than 0.1% of the total value of this crop is invested in better forage management or in the development of improved forage cultivars. Grazing trials are almost nonexistent now due to the high cost of such research.

The Canadian Forage Council was established to:

- support the development of all areas of Canada's forage industry including production, protection, harvesting, storage, utilization, and marketing of forages and forage products

- initiate and support programs and policies to improve the efficient utilization of forages and forage products

- assist in the promotion and priorization of research for the forage industry and encourage additional research when it is considered appropriate by the Council

- form a valuable communication link among public and private companies and interested organizations across Canada

- actively assist in distributing the latest information on forage production through producer meetings and the publication of pamphlets and periodicals.

The American Forage and Grassland Council has been a very active organization since its inception 1958, including being the driving force behind the running of the XIV International Grassland Congress which was held in Lexington, Kentucky in 1981. They publish a regular newsletter with up-to-date research reports, State Council reports, and have an annual 3-day conference.

They sponsor through State Councils Forage Field Days, organize workshops on specific topics such as Alfalfa Hay Quality Testing, and have also awarded members travel grants to attend overseas grassland conferences.

Joint meetings with Cattlemen's Associations etc. have made significant contributions in getting the message out on advances in hay, silage and pasture quality, symposia which update the latest in technology or various aspects of forage production and/or utilization and ongoing Farmer Panel surveys are periodically conducted to keep a tab on the feelings of producers. Task forces on subjects such as hay marketing, forage quality assessment, etc. have also been established. Many Canadians, including our leading farmers, belong to this American Forage and Grassland Council. We expect this group to be staunch supporters of a Canadian Council and we would hope that many Manitoba agronomists and producers will take time out to fill in and send in the card attached to the brochure.

THE CEREAL RUSTS IN MANITOBA IN 1986

D.J. Samborski, J.W. Martens, D.E. Harder and J. Chong

Leaf rust and stem rust of wheat developed to very high levels of incidence early in the year in the United States. This resulted in the early appearance of these diseases in Canada. Leaf rust was first found in southern Manitoba on June 5. The infections were well developed suggesting that the initial infection had occurred about mid-May, two to three weeks earlier than usual. Stem rust was first observed in southern Manitoba in the third week of June. The inoculum density of stem rust reached the highest level in over 30 years but, except for winter wheat, there was little or no damage to the crop. Leaf rust caused some crop losses but a severe epidemic of other leaf diseases such as tan spot and septoria was probably more important than leaf rust in causing yield losses in most cases. Katepwa, which is less resistant to leaf rust than Columbus or Benito, was not heavily infected even though there was a lot of inoculum. The durum wheats were not damaged by rust in Manitoba.

The genetic resistance to leaf rust and stem rust in the spring and durum wheats saved Manitoba producers tens of millions of dollars in 1986.

The 1986 rust race survey is not yet completed but to date there is no evidence for dangerous new races of either leaf rust or stem rust that could attack our resistant varieties.

Manitoba produced 42,000 ha of Norstar winter wheat in 1985-86. The crop was infected by both leaf rust and stem rust early in the season and both diseases developed rapidly. Many growers sprayed with recommended chemicals and delayed the development of the rust but no field escaped damage. Reports of crop losses in the range of 20 to 50%, relative to chemically protected areas or to resistant spring wheat, were common.

The outbreak of oat crown rust in the Red River Valley, southeastern Manitoba, and southeastern Saskatchewan in 1986 was one of the earliest and most severe in recent years. Inoculum of crown rust arrived in southern Manitoba in mid-June, which is much earlier than normal. Conditions were favorable for subsequent development of the disease. The widespread use of the resistant cultivars Fidler (39.4%) and Dumont (39.70%) in Manitoba was effective in reducing the incidence of crown rust; neither of these cultivars were damaged by rust. However, significant losses occurred in late sown fields of susceptible cultivars such as Harmon. In contrast to crown rust, the incidence of oat stem rust in the rust area of the Prairies was one of the lightest in recent years. Only trace infections were detected on wild or cultivated oats throughout the growing season.

Incidence of Root-Rot in Cereals in Relation to Cropping Sequence.
A.V. Sturz and C.C. Bernier, Dept. Plant Science, University of Manitoba.

A cooperative study with the Manitoba Department of Agriculture was devised to assess the prevalence of take-all and other crown and root rots of spring and winter wheat in Manitoba. Forty-five fields across Manitoba were examined. Plants (40 per field) were sampled when they had reached growth stage 10.5 - 11.00 (Feekes) and the fungal pathogens from the crown and root systems were isolated and identified to the species level. Data concerning the time of planting, general appearance of the crop, field topography and previous cropping history extending back over 4 years was also collated for the survey. The results presented here are based on over 8,000 fungal identifications.

Results and Summary

Fungi isolated were identified to the species level and pathogenicity trials were performed. Five fungal species capable of causing serious crown and root disease in cereals were frequently recovered. They included *Gaeumannomyces graminis var.tritici* (Take-all), *Cochliobolus sativus* (Common Root Rot), *Gerlachia nivalis* (Fusarium snow mold), *Fusarium culmorum* (Fusarium Root Rot) *Fusarium avenaceum* (Fusarium Seedling Blight.)

General differences were observed in the percent frequency isolation and composition of pathogenic fungal species colonizing the crown and root tissues in spring as compared to winter wheat. The percent frequency isolation of *C. sativus* and *F. culmorum* tended to be marginally higher in spring as opposed to winter wheat. *G.g.tritici, G.nivalis* and *F. avenaceum* were found almost exclusively in first and second year winter wheat. However rotations which incorporated 2 to 3 years continuous cropping with cereals or grasses did promote the survival and build-up of these pathogens in spring wheat. Summer fallowing did not appear to be a sufficiently adequate 'break' with regards to lowering levels of *G.g.tritici* in wheat crops planted in conjunction with hay rotations.

The percent frequency recovering of *G.g.tritici* increased with each cereal crop over a three year period. As a very general observation, the level of recovery of *G.g.tritici* in the third year of a continuous cereal cropping regime incorporating spring wheat was only slightly higher than one year's cropping to winter wheat.

Bearing in mind the limitations of any survey of this type, no regional differences could be detected in the frequency recovery of any of the fungal pathogens isolated. Cropping sequence appeared to be the primary criterion in determining the level of *G.g.tritici* recovered. Rotations of winter wheat and to a lesser extent spring wheat, resulted in increased levels of *G.g.tritici* and *C. sativus*. Oat rotations favoured the build-up of *F.culmorum* and *F.avenaceum*. Barley favoured the build-up of *C.sativus* and maintained populations of *G.g.tritici* at agriculturally significant levels. A one year rotation away from winter wheat with canola or flax was not sufficient a break to erradicate *G.g.tritici*, however it did reduce *G.g.tritici* to lower levels than those following barley or winter wheat.

The Incidence of Smut Diseases in Cereals in Manitoba from 1983 to 1986

J. J. Nielsen and P. L. Thomas
Agriculture Canada, Research Station, Winnipeg

The following table summarizes the results of field surveys on the smuts of wheat, oats and barley in the past 4 years.

		Mean % infected plants in all fields examined			
Crop	Type of Smut	1983	1984	1985	1986
Common Wheat	Loose	0.1	0.1	0.3	0.1
Durum Wheat	Loose	0.1	0.3	0.1	0.1
Oats	Loose and Covered	0.1	0.2	0.1	0.2
Barley	Loose	0.9	0.4	0.7	1.1
	False Loose	0.1	Trace	0.1	0.1
	Covered	Trace	0.1	0.2	0.2

Wheat: In common wheat two groups of cultivars, each with a very much different reaction to loose smut, contributed to the mean percent infection reported above. In 1986 for instance, 16% of the fields with cultivars such as Benito, Columbus, Katepwa and Neepawa showed some infection by loose smut, with a mean at 0.01%, and a maximum of 0.5% in one field. In contrast, 78% of the fields with semidwarf cultivars showed infection, with a mean of 1.2%, and a maximum of 7% in one field, equal to a loss in yield of 7%. Producers are advised to treat seed of semidwarf cultivars with a fungicide registered for the control of loose smut.

Oats: The incidence of smut in oats is slowly declining, after a peak in 1981. Since the recommended cultivars are resistant, a further decline is expected in future.

Barley: Barley crops in some areas of Manitoba are now showing more loose smut than has been evident for decades. A combination of factors is responsible for this. All cultivars now grown are susceptible to the predominant race of the fungus. Inoculum is present in 80-90% of fields. Moist conditions at flowering in 1985 in the Red River valley and some other areas thus resulted in more infected seed and thus more smutted plants in the 1986 crop. Conditions in 1986 in these areas again appeared to favour infection. Therefore, relatively high levels of smut are expected in the 1987 crop unless infected seed is treated with a recommended fungicide. The Seed Laboratory of the Food Production and Inspection Branch of Agriculture Canada will test seed for the presence of loose smut for $19.00.

RUST AND LEAF SPOT DISEASES OF WHEAT IN MANITOBA IN 1986

J. W. MARTENS, A. TEKAUZ and G. PLATFORD

Conditions were favorable for disease development on wheat in the Great Plains of North America in 1986. Both stem rust and leaf rust overwintered well in the southern United States and there was an abundance of susceptible cultivars to permit the rusts to develop. Some susceptible cultivars in Texas were killed by stem rust early in the year. Leaf rust overwintered as far north as Kansas. According to Dr. Alan Roelfs, USDA cereal rust pathologist, the rusts may have overwintered as far north as the Dakotas and Montana, an event that is believed to be quite rare. These factors combined to create one of the earliest and heaviest buildups of rust inoculum in over 30 years. At the same time, the leaf disease inoculum provided by continuous cropping and other essential soil protection measures combined with adequate moisture to create ideal conditions for the development of these diseases in Manitoba early in the season.

Leaf rust was first found in southern Manitoba on winter wheat on June 5. The infections were well developed, suggesting that the initial infections had occurred about mid-May, two to three weeks earlier than usual. Stem rust was first observed in the third week of June, again very early in the season. The rusts developed very rapidly on susceptible wheat, increasing from trace infections to 80% plus in about four weeks.

Fortunately, all of our recommended spring wheats, including the durums are resistant to stem rust so that, even though there was a lot of rust inoculum, there was no damage, except to winter wheat and small areas of susceptible spring wheat, such as Fielder.

The leaf rust resistance of Columbus, Benito, Sinton, Glenlea, HY320 and the durums continues to be good. Katepwa, the dominant cultivar in Manitoba (46%) which is less resistant to leaf rust than the previously listed cultivars, suffered some damage but developed less rust than expected in 1986. Neepawa was the most heavily leaf rust infected recommended cultivar. Norstar winter wheat was heavily infected by both rusts throughout the province and severe yield and grade losses resulted.

Tan spot and septoria leaf spot developed rapidly early in the season and were prevalent throughout the province, especially in the Interlake and the south-western parts of the province. Drier weather in mid- to late-July and August slowed the development of the epidemic and prevented heavy flag leaf infections in most areas. Lower leafs were generally severely infected and often dead by the milk stage of plant development. The incidence of glume blotch and bacterial black chaff was quite light except in early seeded crops. Generally, late seeded crops had lighter infections of both leaf and head diseases and suffered little crop loss in most cases.

Crop losses and chemical disease control - it is difficult to determine accurately the losses caused by specific disease factors on the different cultivars of wheat. A best estimate would be provided by replicated trials, at several locations throughout the province where diseases were completely controlled in one treatment, the rusts in another and the leaf spots, but not the rusts, in a third treatment. Unfortunately, most of the available data are of an emperical nature, either producer estimates or from field demonstrations and must be recognized as such.

Everyone involved agrees that winter wheat in Manitoba was severely damage by the rusts in 1986. In replicated trials at Minto, David Rourke of AgQuest achieved yield increases of 31% (4033 kg/ha vs 3055 for the control) by partially controlling the rusts with two applications of Dithane M45. Growers have reported yield reductions of 20 to 50%, relative to chemically protected winter wheat or to resistant spring wheats, and a few reported near total crop failures. An overall loss estimate of 1000 kg/ha (15 bu/ac) on the 42,000 ha of Norstar in Manitoba is probably on the low side. If we assume a value of $90 a tonne the loss in Manitoba equals $3.7 million.

Factoring the costs of control measures, the interaction of rust damage and damage caused by other leaf diseases and the fact that wheat not produced is not harvested, transported or held in inventory are beyond the scope of this presentation. Clearly the rusts caused a lot of yield, quality and profitability loss in winter wheat in 1986, probably more than the $3.7 million estimate.

Assuming 1000 kg/ha as a minimum estimate of the potential loss due to rusts in spring wheats and a value of $100 a tonne, the genetic rust resistance in the Manitoba spring wheat crop (1.9 million ha) was worth in excess of $190 million, very clearly indicating that publicly funded research pays big dividends.

The incidence of and damage caused by leaf spot diseases in spring wheat was more varied than that caused by the rusts in winter wheat. Severity varied with date of planting, with early planted crops being most affected. Estimates of losses caused by leaf diseases are based primarily on the yield increases obtained by protecting Katepwa, which however is not fully resistant to leaf rust, in unreplicated field demonstrations (8-16 ha area) coordinated by Manitoba Agriculture Regional agronomists in all five agricultural regions of Manitoba.

Dithane M45 and Tilt, protective and systemic fungicides, were applied at recommended rates. In the central region Dithane M45 and Tilt increased yields of Katepwa from 2703 kg/ha to 3410 kg/ha (26% increase) and 3692 kg/ha (37% increase) respectively, primarily by controlling septoria leaf spot which reached levels of over 50% infection on flag leaves of unprotected plants by mid-August.

In the Interlake region, Dithane M45 and Tilt both increased yields of Katepwa from 3026 kg/ha to 3295 kg/ha, a response of less than 10%.

In a replicated trial with HY320, Marshall, Oslo, Wheaton, Glenlea and Katepwa, using Tilt to control primarily tan spot and septoria leaf spot, David Rourke of AgQuest reported yield increases of 23 (4221 vs 4784), 8, 13 (4221 vs 4784), 16, 4 and 17% (3572 vs 4172) respectively. The differences for HY320, Oslo and Katepwa were significant. The Katepwa increase may be due in part to leaf rust control.

Thus, leaf diseases of wheat, other than leaf rust, caused yield reductions in some areas but it is difficult to estimate the loss for Manitoba; an 8-10% loss overall may be a reasonable estimate.

Is chemical control of the rusts and leaf diseases cost effective? Protection cost an estimated $30-40 ha in 1986. A good crop of winter wheat, threatened by a severe rust epidemic early in the season, is clearly worth protecting. In spring wheats resistant to both rusts, probably more often than not, it would be difficult to recover the cost of treatment.

The 1986 disease situation illustrates the importance of maintaining a very strong emphasis on selecting for disease resistance in wheat improvement programs on the Canadian Prairies; the benefits far exceed the costs!

FUSARIUM HEAD BLIGHT OUTBREAK IN MANITOBA IN 1986

A. TEKAUZ[1], R. M. CLEAR[2] and L. A. COOKE[2]

[1]Agriculture Canada, Research Station, Winnipeg, and [2]Canadian Grain Commission, Winnipeg, Manitoba.

In 1986, fusarium head blight (FHB) was detected for the third consecutive year in Manitoba wheats. Until its appearance here in 1984, this disease had been a problem primarily on grain produced in eastern Canada, and in particular on soft white winter wheat grown in southern Ontario. FHB, or scab, can also affect other cereals - barley, oats, rye and corn. It causes losses in grain yield, but more importantly, may result in the contamination of the grain with mycotoxins. These mycotoxins are secondary metabolites produced by the causal agent(s) of the disease, Fusarium fungi, of which F. graminearum is the most common. Of the mycotoxins produced, deoxynivalenol or "vomitoxin" is most often found in infected grain samples. The presence of mycotoxins in the grain can affect its palatability and marketability.

FHB is not a new disease to Manitoba or to western Canada, but the recent outbreak is the first to be reported for about 25 years. Based on seed samples from which F. graminearum was isolated, the outbreak area in Manitoba has been expanding annually since 1984 (Fig. 1).

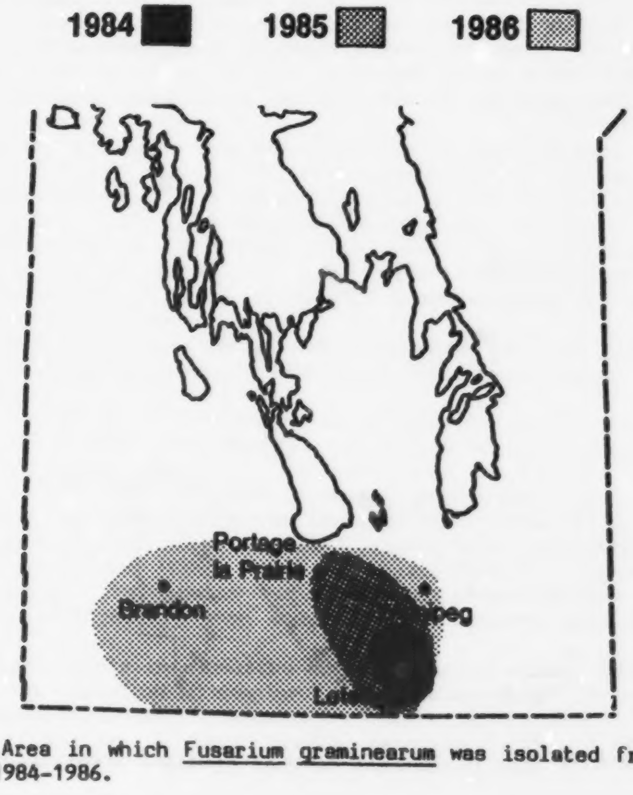

Fig. 1. Area in which Fusarium graminearum was isolated from wheat samples, 1984-1986.

In Ontario, the occurrence of FHB in wheat is influenced by the production of corn because this crop is also a host for the disease. Infected corn residue in which the fungi can overwinter, provides an abundant source of inoculum for infection the following spring. Sowing of wheat after corn has been found to greatly increase the severity of FHB, and this rotation is therefore not recommended.

Corn production has increased in Manitoba, and the localized detection of FHB in 1984 appeared to be related to a corn/wheat rotation. However, in subsequent years FHB was detected in wheat fields where neither corn nor wheat had been grown the previous season. Head blight in corn has not yet been reported in Manitoba.

In 1984 and 1985, FHB was identified in Manitoba on the basis of the appearance of harvested grain samples containing shrivelled, chalky-white kernels, commonly referred to as "tombstone". In 1986, FHB was detected as a disease in the wheat crop prior to harvest. Field symptoms were striking, appearing as bleached spikelets or heads which contrasted with the normal green of healthy ones. The bleaching was frequently accompanied by a salmon-pink discolouration of glume margins and spikelet bases. It should be noted that premature senescence can also be caused by other disorders such as feeding by the wheat stem maggot, which results in bleached stalks and heads; and infection by common and take-all root rots which may cause bleaching of the entire plant. With FHB, however, only the heads are bleached.

The incidence of FHB in 67 Manitoba wheat fields in 1986 is shown in Fig. 2. The disease was relatively common to areas south-east and south-west of Winnipeg, but was rarely found to the north in the Interlake region. Based on percent diseased heads, the most severe infections were found in the Red River Valley, south of Winnipeg. The occurrence and severity of the disease in various wheat classes is shown in Table 1.

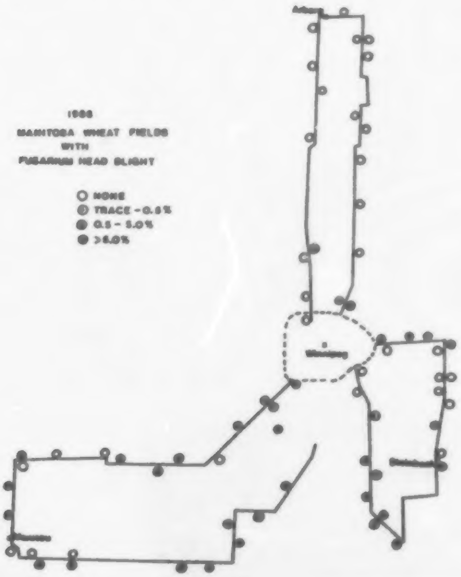

Fig. 2. Fusarium head blight in fields of Manitoba wheat in 1986.

Table 1 : Incidence and severity of fusarium head blight in 67 Manitoba wheat fields surveyed in 1986

Disease Severity[a]	Wheat Class			
	"Semi-dwarf"	Amber Durum	Hard Red Spring	All
None	1[b]	1	30	32
Trace (Tr-0.5%)	9	1	12	22
Light (0.5-5.0%)	5	1	1	7
Moderate[c] (>5.0%)	5	1	0	6
Total	20	4	43	67

[a] based on percent infected heads
[b] no. of fields
[c] up to 25% infected heads

Virtually all surveyed fields of semi-dwarf wheat were infected with FHB and in half, disease severity exceeded trace levels, including three fields with 15-25% infection. In durums, a similar pattern occurred, however only four fields were sampled. In contrast, only 30% of hard red spring (HRS) wheat fields were infected, primarily at trace levels. In HRS wheats, infected heads usually only had one or two diseased spikelets, whereas those of semi-dwarf and durum wheats were 25 to 100% diseased.

In 1986, field symptoms of FHB were also reported from a few scattered locations in western Manitoba, eastern Saskatchewan and central Alberta.

The Canadian Grain Commission, as it has done in previous years, analyzed suspect 1986 grain samples for levels of tombstone kernels, species of Fusarium fungi, and any associated mycotoxins. Table 2 shows the frequency of isolation of five Fusarium spp. known to cause head blight. F. graminearum was isolated most frequently, and its presence was used to confirm a suspect sample as a FHB-positive one. Canada prairie spring (CPS) and durum wheats had the highest total levels Fusarium. HRS wheats had considerably lower amounts of F. graminearum, particularly when comparing all suspect samples (Table 2).

Tombstone levels in submitted suspect samples were: amber durum wheats - 0.68% (based on 60 samples); CPS wheats - 1.09% (13 samples); and HRS wheats - 0.12% (51 samples). Levels higher than 0.5% tombstone were found in 16 durum samples (average 1.58%), 5 CPS wheat samples (average 2.28%) but in none of the HRS wheats.

Table 2 : Frequency of *Fusarium* species known to cause head blight, in 1986 Manitoba wheat samples.

	Wheat type					
	Amber Durum		Canada Prairie Spring		Hard Red Spring	
Fusarium spp.	FHB-positive[a]	all[b]	FHB-positive	all	FHB-positive	all
F. graminearum	11.0[c]	7.2	11.7	8.0	2.8	0.7
F. sporotrichioides	4.3	4.0	2.8	2.3	1.4	0.4
F. avenaceum	-	4.0	-	1.8	-	0.4
F. poae	-	1.0	-	0.5	-	0.7
F. culmorum	-	0.2	-	0.2	-	<0.1

[a] samples positive for head blight
[b] all submitted suspect samples
[c] percent of seeds

Most grain samples that were positive for FHB (tombstone kernels) were analyzed for the presence of vomitoxin. Those with the highest levels of tombstone usually had the highest levels of vomitoxin. In general, tombstone kernel levels higher than 0.5% resulted in vomitoxin levels that approached or exceeded 1 ppm. Based on this information the Canadian Grain Commission set the 1986 western wheat crop maximum tolerance levels for tombstone (Table 3).

Table 3 : Maximum tolerances for tombstone kernels (FHB) in western wheat for 1986[a].

Wheat Class	No. 1	No. 2	No. 3	No. 4	No. 5	Canada Feed
C.W. Amber Durum	0.10[b]	0.25	0.50	1.00	5.00	N/A
C.W. Red Spring	0.25	0.50	1.00			
Canada Prairie Spring	0.50	1.00				
Feed Wheat	N/A	N/A	N/A	N/A	N/A	5.00

[a] established by the Canadian Grain Commission
[b] percent by weight

The general appearance of tombstone kernels has already been described. The overall chalky-white or light grey cast of tombstone kernels in CPS and HRS wheats is more bronze-hued in durums. More detailed observation of such kernels reveals the presence of white or light-coloured mycelium in the crease region.

Fusarium fungi can occasionally produce a pink discolouration on kernels, whether these are tombstone or morphologically normal. In tombstone kernels, the pink discolouration usually occurs at the germ end.

All pink or red seed discolourations are not due to infection by Fusarium fungi. Other agents or conditions can cause such discolourations. These include: Pyrenophora tritici-repentis, causal agent of tan spot (this condition is termed "red smudge" and is most often found in durum wheats); Epicoccum nigrum, a saprophytic fungus which under wet harvest conditions can cause a blood-red pigmentation; kernel immaturity, such as typified by immature kernels of Columbus

Table 4 : Symptoms of tombstone kernels (FHB) and similar appearing conditions.

	Discolouration			Other			
Condition	Chalky White	Pink	Red	Light Mycelium	Dark Mycelium	Sprouting in Sample	Shrunken
FHB "tombstone"	+++ S	+[a] LM		++[c] LM			+++ LMS
Other Fusarium spp.		+++ LMS		++ LMS	+ L	++ LMS	
Epicoccum spp.			+++ LMS		++ LMS	++ LMS	
Red smudge			+++ L				++ L
Treated seed		++ LMS	++ LMS				
Immaturity		+[b] LMS					++[b] LMS

Legend: Frequency of symptom
+ occasionally
++ often
+++ always
Degree of symptom
L light
M moderate
S severe

Notes: [a] germ area
[b] symptoms associated with immaturity in some years
[c] germ and crease area

wheat; and seed-dressing fungicides which can result in a pink or red seed-coat colour. These discolouration can occur anywhere on the seed. A pink or red discolouration on kernels is therefore not necessarily diagnostic of FHB, unless it is accompanied by tombstone symptoms. The characteristic symptoms of tombstone and other similar appearing conditions is summarized in Table 4.

The occurrence of FHB in Manitoba in the past three growing seasons is likely due to a combination of predisposing factors. These include the presence of abundant Fusarium inoculum, frequent or prolonged periods of rain at crop heading, and the increased cultivation of wheat types that are apparently more susceptible to the disease. It is likely that species of Fusarium capable of causing head blight have always been present in Manitoba, but at very low levels. The present abundance of F. graminearum could be due to the increased planting of corn, using seed from Ontario. F. graminearum is common in Ontario corn, causing head blight or "pink ear rot". In addition, inoculum may have multiplied in the several recently-popular semi-dwarf wheats, which from preliminary observations, may be more susceptible to the disease. The inoculum is now widely distributed (Fig. 1).

In summary, fusarium head blight inoculum appears to be locally abundant in the Red River Valley; and the disease seems to be spreading in southern Manitoba. To date, however, the amount of Manitoba wheat infected with FHB has been only a small portion of this province's cereal production. If FHB is going to become a regular disease threat to cereal crops (particularly in CPS and durum wheats) in southern Manitoba, the breeding programs for these cereals will have to attempt to incorporate resistance to the causal Fusarium spp. Annual monitoring for early detection of the disease will be necessary to ensure that potential problems can be dealt with effectively.

DISEASE CONTROL IN PULSE CROPS

G. Platford

There are a number of diseases that attack the pulse crops. Some of these diseases also attack other broad leaf special crops and some are restricted to only one type of plant. There are no disease problems in common with the cereals, corn and grasses. There are a few diseases which attack pulse crops and forage legumes. In order to effectively control plant diseases on pulse crops it is necessary to use a combination of crop rotation, resistant varieties when available and suitable fungicides.

The disease which attack these group of crops can be divided into two broad categories:

1. Non-pathogenic diseases - caused by unsuitable environmental conditions, soil nutrient imbalances, soil moisture, deficiency or excess, etc.
2. Pathogenic diseases caused by fungi, bacteria and viruses.

The first step towards effective disease controlis to identify the cause of the disease problem. Samples of diseased plants can be sent to the Manitoba Agriculture, Plant pathology laboratory in the Agricultural Services Complex, University of Manitoba

The majority of plant disease problems can be further divided into three broad categories:

1. seedling blights, damping off and root rots
2. Sclerotinia white mold and Ascochyta blight
3. fungal leaf spots, bacterial blights, rust, powdery mildew and virus diseases

GROUP I: root rots and damping off diseases

The root rots and damping off group mainly includes the soil borne fungi or soil colonizer organisms, Rhizoctonia, Fusarium and Pythium. These fungi are almost universally distributed in the soil. They are relatively unspecialized and are thus able to attack a broad range of plants. The fungus Rhizoctonia for example causes a stolon and tuber infection of potatoes, a root rot of canola and a seedling blight of flax, beans, lentils and peas. In fact almost all broad leaf special crops are attacked to a greater or lesser degree by Rhizoctonia. There does not appear to be many strains of the fungus so the type attacking canola can also cause a seedling blight or root rot problem on pulse crops. Another characteristic of fungi in the group is that they can survive on dead organic matter in the soil. Fusarium root rot can be quite severe on pulse crops particularly lentils, field beans and fababeans. The Fusarium fungus is more host specific than Rhizoctonia. Fusarium root rot can cause higher losses under dry soil conditions. This group of diseases rarely causes devastating crop losses and are very dependent on weather conditions for their development. Normally a two or three year rotation utilizing cereals, corn and summerfallow will reduce the incidence of Rhizoctonia and Fusarium but will not completely eliminate them from the soil. Plants growing under stress are generally more prone to damage by root rots.

GROUP II: systemic wilts and downy mildews

The second group, the systemic diseases or wilts and downy mildews are classified as soil invader organisms. The fungi that cause diseases in this group are capable of surviving in the soil but do not grow to any appreciable extent on dead organic matter. They exist in the soil as thick walled spores or sclerotia, which often lie dormant for long periods of time. They are generally much more host specific than root rots (eg. Mycosphaerella blight and Ascochyta foot rot of peas and fababeans are each caused by a different species of Ascochyta), but some such as Sclerotinia can have a relatively broad host range. In addition to the dormant soil borne stage many of the fungi in the group have an air borne spore. This combination of long term soil survival and capability of relatively widespread airborne dispersal leads to some of the fungi in the group being very devastating. There are a number of very important plant diseases in this group; Sclerotinia wilt of sunflower, canola, fababeans, field beans, peas, soybeans and lentils; Ascochyta blight of fababeans, and peas. Some success has been achieved in breeding resistant varieties to diseases of this type particularly to Ascochyta blight. The present varieties of fababeans have some resistance to Ascochyta. Field beans are not affected by Ascochyta. Lentils are affected by Ascochyta lentis which is seed and stubble borne, no soil borne phase. Laird lentils are more resistant to Ascochyta blight than Estons. Unfortunately there are no resistant varieties of fababeans, field beans, peas, soybeans and lentils to Sclerotinia wilt. Control of diseases in this group is achieved through use of long crop rotations of four to five years utilizing cereals, corn or grasses and resistant varieties of crop species. More resistant varieties will likely be available in the future to disease in this group. Sclerotinia disease (white mold) disease of field beans can be controlled by an application of Benlate, Bravo or Rovral at blossom time. Thiram is a recommended seed treatment fungicide for peas. There are no seed treatment fungicides recommended for lentils. Selection of lentil seed free of Ascochyta or with only a low level (ie. less than 2%) is recommended for Ascochyta blight control. There are presently no seed treatment fungicides registered for use on lentils against Ascochyta.

GROUP III: diseases of the aerial parts of plants - leaf spot, mildew, rusts and bacterial blights

The fungi and bacteria in this group cause chocolate spot of fababeans, and bacterial blight of field beans, field peas and soybeans, Ascochyta blight and gray mold of lentils. These diseases are primarily spread through the air often for quite a long distance as in the case of rust of field beans. In most cases the disease organism survives mainly only on infected crop stubble and some diseases such as bacterial blight of peas, field beans and soybeans, Ascochyta of lentils also survive on or within seed. A distinct characteristic of this group of diseases is that often they are very host specific. Because of their ability for widespread aerial dispersal of spores many of these diseases can cause devastating disease epidemics. Since they survive primarily on the crop stubble the incidence of inoculum in the field decreases rapidly and usually is at a very low level within two years. Incorporation of the crop debris into the soil further lessens their disease causing potential.

The major means of controlling diseases of pulse crops is through crop rotation. A crop rotationis dependent on:

1. Crops adapted to the region
2. Other agronomic practices such as weed control
3. Previous history of fields. This is especially important with the diseases such as Sclerotinia which can have a prolonged soil survival period.
4. Weather conditions - determine occurrence and severity of many diseases
5. Grower preference. The grower makes the final decision as to what crop he wants to grow. Many growers have had unfavorable experiences with certain crops and will avoid use of these crops in a rotation regardless of its benefit in a crop rotation
6. The type of farm operation often dictates the types of crops that are grown. A livestock producer will have different preferences and requirements as to choice of crop than a farmer producing vegetable crops.
7. Finally the market price of the crop has a decided effect on choice of crop sequence. If the prospect of a disease is low, then market price of yield may be sufficient to cover any loss due to disease. Unless a grower is very familiar with his crop, and their past performance in specific fields this temptation to shorten crop rotation in the anticipation of making up any losses through high market price of the product should be avoided.

A disease control program for pulse crops should include:

1. Use of resistant varieties when available
2. Seed treatments which are registered for use on peas, field beans and soybeans.
3. A fungicide spray for white mold on field beans, Sclerotinia can be used
4. Crop rotation. Most pulse crops should be spaced four years in the rotation to minimize carryover of soil borne disease problems. Shortening of crop rotations can result in disease buildup especially of Ascochyta and Sclerotinia disease. Growers should examine their fields during the growing season and determine identity and severity of diseases before making crop rotation decisions that result in growing pulse crops at less than the recommended interval.

Efficacy and Safety of Fall and Spring Applications of Soil Applied Herbicides

Harvey Glick
Monsanto Canada
Winnipeg, Manitoba

Summary: Avadex BW can be applied in many different ways to fit a wide variety of farming systems. Avadex BW can be applied in the fall or in the spring, either as a granule or a liquid formulation. In the spring it can be applied either before seeding or after seeding. Either formulation can be applied with fertilizer in a one shot 'weed and feed' application. Avadex BW performance will vary depending on how it is applied. In general, fall applications of Avadex BW provide better wild oat control than do spring applications, with the granules performing slightly better than the liquid. Spring applications provide better wild oat control when applied before seeding than after seeding. Avadex BW granules applied after seeding exhibited the least effective control of wild oats relative to the other applications.
Crop tolerance will vary depending on the crop species. However, generally speaking fall applications show the greatest crop tolerance followed by spring post plant applications.

Fortress, a new granular formulation of triallate and trifluralin will effectively control wild oats and green foxtail in a single fall application. This fall application of granular triallate and trifluralin maximizes the safety and efficacy characteristics of these chemical active ingredients.

Introduction: An important characteristic of any herbicide is application flexibility. Farming operations are continually changing and differ dramatically from region to region. The application of a given herbicide must be flexible enough to adapt to these different, and changing needs.
Triallate, the active ingredient in Avadex BW, is a member of the thiocarbamate class of chemistry. This class of chemical compounds typically exhibit a high degree of application flexibility ranging from preplant applications to post emergent applications.
When Avadex BW was first introduced in 1970 it was usually applied as a liquid post plant incorporated treatment (PoPI) just prior to crop emergence. This provided a clear physical separation between the herbicide layer in the soil and the seed which was placed below it and insured crop safety.
Shortly afterwards it was determined that Avadex BW could be applied in the fall and still provide excellent safety and efficacy. The cool soil temperatures in the late fall minimized any microbial degradation and so the Avadex BW remained bound in the soil until the soil warmed up again the following spring. In fact Avadex BW gave consistently superior control of wild oats when applied in the fall compared to spring applications.
Fall application of Avadex BW offered numerous practical

benefits to growers in Western Canada in addition to excellent wild oat control. However,research data indicated that the liquid formulation of Avadex BW applied in the fall gave slightly better wild oat control when applied to summerfallow fields compared to stubble fields. It was speculated that some of the Avadex BW liquid was being tied up on the stubble and was unavailable for weed control. This led to the development and testing of a granular formulation of Avadex BW. Sure enough, this granular formulation provided superior control of wild oats on stubble fields. This formulation became increasingly important as the trend towards reducing unnecessary tillage became more popular.

More recent research has focused on the application of Avadex BW in the spring prior to seeding wheat. In response to increasing interest from the farming community, a spring, preplant incorporated (PPI) application was registered for wheat. It was determined that if the Avadex BW was applied 5-7 days prior to seeding, wild oat control was superior compared to PoPI applications. In general, the earlier the Avadex BW is applied relative to seeding, the greater the wild oat control.

The relative performance of Avadex BW is summarized in Table 1. These data were summarized over 10 years and are based on the appropriate label rates for the particular soil types involved.

Table 1. Relative Triallate Performance in Canada.

	Wild Oat Control (%)					
	Fall 10G	Fall EC	Spr EC PPI	Spr 10G PPI	Spr EC PoPI	Spr 10G PoPI
Early	95%	93%	90%	88%	85%	80%
Late	90%	90%	88%	85%	85%	84%
10yr Avg. Consistency	90%	88%	85%	84%	78%	70%

Notes: 10G - Avadex BW Granular Formulation 10%
EC - Avadex BW Liquid Formulation 400 g/L
PPI - Preplant Incorporated
PoPI - Postplant Incorporated
Early - Wild Oat Control Rated 30 days After Treatment
Late - Wild Oat Control Rated 60 days After Treatment
Consistency - Number of times the % Wild Oat Control was achieved over 10 years.

Researchers have determined that the liquid formulation of Triallate is initially more available, and therefore faster acting, than the granular formulation. This would explain why the liquid formulation is more efficacious in spring PPI and PoPI applications. The granular formulation is less susceptible to loss by volatilization and is more 'trash proof' than the liquid formulation and this explains why the granules outperform the liquid triallate in the fall.

Uniform distribution of Triallate in the soil contributes greatly to the level of wild oat control. Fall applications of triallate generally result in more uniform distribution than spring applications and this explains why wild oat control is superior with fall applications of triallate.

Crop tolerance is less well defined because of the variable response to soil organic matter, clay content and moisture.

However, in general terms, fall applications and spring PoPI applications exhibit greater crop tolerance than spring PPI applications.

In Manitoba, a popular treatment for control of wild oats and green and yellow foxtail is a combination of Avadex BW plus Treflan (Triallate plus Trifluralin). Typically, this treatment is applied as a liquid postplant spray application. While this treatment provides very satisfactory results, it is clear from the results in Table 1 that even greater performance could be obtained from granular applications in the fall or applied in the spring as a Preplant treatment.

As a result of an extensive research program, Monsanto has introduced Fortress, a granular herbicide for the control of wild oats and green and yellow foxtail in cereal and oilseed crops. Fortress is currently registered for fall applications anytime after Sept. 15. A spring Preplant application is also pending.

Fortress offers a number of benefits to producers in Manitoba and all of Western Canada. It provides superior control of wild oats and green foxtail in a single application. Residual control lasts for five to eight weeks to control the weeds when they emerge throughout the growing season. Fortress is non toxic and provides minimal risk to applicators. Container disposal is simple and there is no need to supply water for application. The fall application spreads out the workload and leaves time for seeding in the spring. Finally, Fortress is a pre-emergent herbicide that controls weeds underground before they begin competing for moisture and nutrients and offers growers maximum yield potential.

THE QUACKGRASS ACTION COMMITTEE

Barry Todd
Manitoba Agriculture

Quackgrass is a native of Europe and was introduced to New England during colonization. It was probably introduced to Quebec during this same period and then moved westward during the early years of European settlement. The rapid spread of quackgrass through western Manitoba and eastern Saskatchewan has been attributed to the sowing of infested bromegrass and transportation of infested hay.

So successful has quackgrass been that its range in Canada extends from Newfoundland to British Columbia and as far north as Goose Bay in Labrador and Fort Smith in the Northwest Territories.

Although quackgrass does possess some beneficial attributes, principally as a forage, it does exert a major detrimental impact on agricultural production in Canada.

Quackgrass represents an impediment to the production of a wide variety of commodities, and its impact is increasing as we move more and more towards minimum tillage crop production.

To develop an appreciation for the magnitude of the losses caused by this weed, one must look at the impact of quackgrass in some individual crops.

In potatoes, quackgrass can cause severe yield reductions. In Michigan, quackgrass reduced potato yields by 52 to 70%, with the higher losses occuring with higher levels of fertilizer nitrogen. In the Maritimes, it has been estimated that losses due to quackgrass in potatoes amount to $4,000,000 annually. In addition to yield losses, quackgrass rhizomes can penetrate potato tubers, resulting in downgrading. The lost value attributable to reduced quality can also be significant.

In the forage area, quackgrass has had a major impact on forage seed production. Quackgrass has been identified as the single factor preventing the production of chaffy grasses for seed in Manitoba. Thus, an opportunity for diversifying production is lost unless the quackgrass problem is addressed. In established alfalfa seed fields, quackgrass has reduced seed yields by 50% and shortened stand life.

In cereal crops, yield losses are also significant. Anyone who has walked a wheat field knows that quackgrass patches can reduce wheat yields to zero. Because of the patchiness of quackgrass it is difficult to develop accurate estimates of yield loss at various quackgrass density. However, on a national basis it is estimated that quackgrass causes annual yield losses of $200,000,000 in four major field crops - wheat, barley, corn and soybeans.

While lost production is certainly a concern, a much larger issue remains. That issue is the limitation imposed by quackgrass on the adoption of minimum and zero tillage crop production practices.

It is interesting to note that quackgrass can be effectively controlled through intensive tillage, particularly in association with summerfallow. While the development of glyphosate herbicide offerred an alternative to tillage, the difficulty in achieving suitable post-harvest conditions for effective control, and cost have limited the use of this treatment.

With continuous cropping, less tillage, and the use of higher levels of fertility, the quackgrass problem has begun to spread more rapidly. However, farmer awareness of this problem appears to be relatively low, and research efforts directed towards development of more effective quackgrass control programs are limited.

It is within this context that the Expert Committee on Weeds has established a National Quackgrass Action Committee.

The major objectives of this committee are:

1. To summarize the current body of research knowledge on quackgrass.
2. To increase awareness of the magnitude and the extent of the quackgrass problem.
3. To provide direction and coordination to various research organizations addressing the quackgrass problem.
4. To provide a forum for exchange and dissemination of information on quackgrass and its control.

In order to address these objectives, a national seminar on quackgrass has been organized. It will be held on March 10 and 11, 1987 at the Westin Hotel in Winnipeg. As Chairman of the National Quackgrass Action Committee I would like to extend an invitation to you to participate in this workshop and assist in the development of a coordinated action plan to tackle this troublesome perennial weed.

DPX M6316 - A NEW BROADLEAF WEED CONTROL PRODUCT FROM DU PONT

DPX M6316 is a new selective postemergence herbicide from Du Pont which controls a wide range of broadleaf weeds in cereals.

DPX M6316 has a number of characteristics that ideally suit it for cereals production in Manitoba. It is a highly active product with an effective use rate of between 20 to 30 grams product per hectare. Just over one pound of product at this rate will treat 40 acres of cereal cropland. The product is easy on cereals. Spring wheat, winter wheat, durum, barley and oats have all exhibited excellent tolerance to DPX M6316 and the product is safe to the user. Toxicity to humans is very low, it is neither a skin irritant nor a skin sensitizer. It is ordorless and is not volotile.

DPX M6316 has shown excellent field activity on many weeds. (SLIDE 4) Shown on this slide is a partial list of the weeds that M6316 has shown good activity on at 30 grams product per hectare. For the future our field work will further define this control list. M6316 does not control grassy weeds, Canada thistle or sowthistle.

These slides show the control noted for certain weeds in the field. M6316 is rapidly taken up by both foliage and roots with growth in susceptible plants stopping very soon after application. Typical symptoms of broadleaf control include wilting followed by chlorosis and death of the affected weed. Although growth and therefore competition to the crop is stopped quickly, visual evidence of weed death can be slow. Warm moist conditions hasten the visual symptoms of control while weeds under growth stress at application can take up to two weeks before exhibiting control symptoms.

DPX M6316 can be tank mixed for wild oat control with Mataven, Hoegrass and Avenge. Research is ongoing to determine if M6316 mixed with Hoegrass can provide acceptable green foxtail control.

DPX M6316 is not residual in the soil. This gives the grower the option of growing any crop on land previously treated with M6316. Research has shown very rapid degradation with susceptible crops growing on soils treated with M6316 in just a few weeks after application.

DPX M6316 is formulated as a 75% dry flowable product making container storage, measurement and farmer use very easy. It is to be mixed in water and applied as a broadcast spray. Testing has shown that for consistent results surfactant used at 0.25% volume to volume gives the best control for the wide range of Canadian weeds and conditions.

For 1987 Du Pont will apply for a Research Permit to obtain more commercial scale results and data which will be used to support product registration. Registration of DPX M6316 may come as early as 1988. To see this product become registered as soon as possible you can help by showing your support to Ottawa on the need for new products such as M6316. The Registration Group in Ottawa needs your feedback that this product can be a valuable tool in Manitoba's cereal production.

DPX M6316 is a unique new postemergence herbicide for cereals. The wide range of weeds controlled, the excellent crop safety, low use rates, flexible crop rotation and the safety to the end user make DPX M6316 an excellent product for the Manitoba Cereal Producer.

POAST AND POAST & AMMONIUM SULPHATE
FOR GRASSY WEED CONTROL

George H. Friesen
Agriculture Canada
Morden, Manitoba, R0G 1J0

Poast (sethoxydim) is a relatively new herbicide belonging to a group of products commonly referred to as graminicides. These graminicides control annual grassy weeds, volunteer cereals and corn, and several perennial grasses including quackgrass (2). In Canada, Poast is registered for use in most broad-leaved crops including flax, rapeseed/canola, soybeans, dry common beans, sugar beets, field peas, potatoes, tomatoes, onions and snap beans. Tank mixtures of Poast & Lontrel and Poast & Bladex for use on rapeseed/canola, and Poast & Sabre or Buctril M for flax, are also registered. To date, Poast has not been registered on sunflowers, lentils, fababeans, safflower, tame buckwheat or tame mustard.

As field testing of Poast began in the late 1970's, it was soon observed that the herbicidal activity could be increased by adding a small amount of an oil-based surfactant (3). Subsequent research demonstrated that seed yields in flax and rapeseed were increased 10-30% by applying Poast and Assist Oil Concentrate for the control of wild oats, green foxtail, volunteer barley and volunteer corn (4,5). More recently, research has demonstrated that the addition of small amounts of ammonium sulphate [$(NH_4)_2SO_4$] to Poast & Assist further enhanced the herbicidal activity against grassy weeds, at least under some conditions (1, 6). Due to environmental concerns about pesticides and the rising costs of herbicides, such attempts at minimizing herbicidal requirements by adding low cost adjuvants while at the same time maintaining acceptable levels of weed control, are encouraging. In practical terms, this research has resulted in lower the rates of Poast now being recommended for the control of volunteer wheat, barley and quackgrass (Table 1).

A 'package' consisting of Poast, Assist and Ammonium Sulphate is now marketed by BASF Canada as "Power Pack".

The purpose of this paper is to review some of the field research conducted in Western Canada during the past few years on the influence of ammonium sulphate on the performance of Poast & Assist. The discussion will be in 3 parts:

1) Control of annual grassy weeds.
2) Control of volunteer wheat and barley.
3) Control of quackgrass.

Control of annual grassy weeds

The control of wild oats and green foxtail with sethoxydim does not appear to be enhanced significantly by the addition of ammonium sulphate (Table 2). This may be due to the high susceptibility of these weeds to sethoxydim. Research at rates of 50 to 100 g/ha of sethoxydim, with and without ammonium sulphate, may be warranted.

Control of volunteer cereals

The control of volunteer wheat and barley with sethoxydim is enhanced considerably by the addition of ammonium sulphate (Table 3).

This increased herbicidal activity has resulted in lower rates of sethoxydim being recommended for the consistent control of volunteer cereals in flax, canola/rapeseed and other broadleaved crops.

Control of quackgrass

The control of quackgrass with sethoxydim is also enhanced with the addition of ammonium sulphate, particularly in Alberta & Saskatchewan (Table 4). In Manitoba the response has been negligable, to date. Further research will be required to clarify this lack of response in Manitoba.

Conclusions

Chow & MacGregor (6) investigated the possibility that ammonium sulphate may increase the penetration of sethoxydim into the plant. Permeability, when measured by leaked solute conductivity of corn leaf discs, was significantly increased by ammonium sulphate. The combination of ammonium sulphate and oil concentrate resulted in the greatest degree of solute conductivity. It was 27% higher than that achieved with sethoxydim and oil concentrate alone. If this can be positively correlated with sethoxydim uptake, it would help to explain the enhancement in activity observed with the use of ammonium sulphate on some weeds.

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TABLE 1: Label rates of Poast

	Poast rate (kg/ha)	
Weed	Without AmSul	With AmSul
vol. wheat	0.3	0.25
vol. barley	0.3 (a)	0.25
quackgrass	0.8	0.5

(a) Under heavy infestations apply 0.35 kg/ha.

TABLE 2: Control of wild oats and green foxtail with sethoxydim plus adjuvants, 1984-85 (2).

Treatment			Control of Wild Oats		Control of Green Foxtail	
Poast	Assist*	AmSul	Western Canada (9)	Morden (1)	Western Canada (3)	Morden(1)
kg/ha	% (v/v)	L/ha	----------------- % stand reduction --------			
0	0	0	0	0	0	0
0.15	0.5	0	87	100	100	100
0.15	0.5	4.0	94	100	100	100
0.25	0.5	0	98	100	100	100
0.25	0.5	4.0	97	100	100	100

* Assist or Atplus 411

TABLE 3: Control of volunteer cereals with sethoxydim plus adjuvants, 1984-85 (2).

Treatment			Control of vol. barley	Control of vol. wheat
Poast kg/ha	Assist* %(v/v)	AmSul L/ha	(7)	(7)
			---- % stand reduction ---	
0	0	0	0	0
0.15	0.5	0	57	73
0.15	0.5	4.0	87	86
0.25	0.5	0	84	92
0.25	0.5	4.0	95	97

* Assist or Atplus 411

TABLE 4: Control of quackgrass with sethoxydim plus adjuvants, 1984-85 (2).

Treatment			Control of quackgrass		
Poast kg/ha	Assist* %(v/v)	AmSul. L/ha	Alta. (4)	Sask. (6)	Man. (7)
			-- % stand reduction ---		
0	0	0	0	0	0
0.35	0.5	0	-	57	80
0.5	0.5	0	77	85	84
0.8	0.5	0	83	90	88
0.35	0.5	4.0	80	78	81
0.5	0.5	4.0	85	86	85
0.8	0.5	4.0	-	92	88

* Assist or Atplus 411

ECONOMIC CRISIS - HOW DO WE COPE?

I heard a speaker at a recent conference I attended say in reference to the USA - EEC trade war that when the big guys fight, the little guys drown in the blood. For most Manitoba farmers, I'm afraid the real blood bath is just beginning. I might add, I've always considered myself to be an optimist not a pessimist. The reason I say it is just beginning for most Manitoba farmers is that unlike many Saskatchewan and Alberta farmers, we have had above average crops. Not only have we had good yields, but much of the quality has been good, particularly in the southern part of Manitoba's farm belt. Added to this, we have been able to sell it all. Coupled with this, Western Grain Stabilization has been good to Manitoba. We had good yields, made maximum contributions, and hence got maximum payouts when crop shortfalls in the west triggered a payout. Agriculture Canada forecasts that net farm income for Manitoba is to jump 20% in 1986; Saskatchewan and Alberta net farm incomes are to fall 12% and 5% respectively. This bears out what I have said; that Manitoba farmers haven't yet felt the real crunch that parts of Saskatchewan and Alberta have. However, the 86-87 crop year appears to be a horse of a different colour. Keep in mind when we talk of the farm economy the livestock sector, particularly hogs and poultry, are doing very well. The sector that is suffering is the grain sector in particular.

For the 86-87 crop year, yields were average to above average in most areas. However, quality was down, particularly in durum wheat and in canola. Spring wheat quality was average, some 1 and 2, and some 3 and Canada feed. Malting barley quality was better than last year and flax was up in yield with good quality. That's the good news. The bad news is, it's not worth much, a 25% drop from last year coupled with the fact we won't be able to move it all.

TABLE I

		85/86	86/87	% Change
Hard Red Spring Wheat	No. 1	$146.80/tonne	$116.70	(21%)
	No. 2	140.92	110.83	(21%)
	No. 3	132.85	96.88	(27%)
Durum Wheat	No. 2	143.86	113.27	(21%)
	No. 3	142.03	111.87	(21%)
	No. 4	125.88	86.61	(31%)
Barley Special Select		150.55	150.55	(0)
1 C.W.		95.47	64.72	(32%)
Flax	1 C.W.	approx. 315.00/tonne	approx. 190.00/tonne	(39%)
Canola	1 Can.	approx. 264.00	approx. 220.00	(17%)

If you put these prices into a budget you will find it takes nearly a 30 bus. crop of No. 2 wheat to cover your operating costs and nearly a 60 bus. crop of 1 C.W. barley to cover operating costs only.

Now given this situation, what does a producer do as he prepares for the proverbial "next year"?

As I see it, there are two areas where he can help manage his own destiny.

(1) What you do in terms of hands-on management of your own business - crops, inputs, credit, etc.

(2) What you do in the wider agricultural forum re improving the lot of farmers.
- by this I mean working through your various farm organizations with government and industry people to see that monies put into agriculture are used so agriculture derives maximum benefit.

I. Dealing with the first area, that of management consideration.

DEBT

Most producers are exercising a lot more caution in their dealings, whether your talking land, machinery, rentals, whatever. Or as one fellow at the local think tank (that's our coffeeshop) put it, "It's time to dig in and keep your head down". With regard to debt, farmers are doing that, they are paying off loans and borrowing only what's necessary. I think you're seeing an indication of that now in the major capital purchases such as land and machinery. Sales have dropped off more than the decrease in cash receipts would indicate they should have. It's indicative of the attitude re debt at the farm level.

I've farmed for the last 20 years with my Dad who farmed through the 30's. I'm sure I heard the story 20 times about how they almost lost the home section over a mortgage on one other quarter. It affected my Dad's attitude re debt for the rest of his life. He knew it was necessary but needed to be used with caution as conditions can change. In the beginning I was a non-believer, but I can now see the wisdom of his advice.

For those who are in good financial shape, these times present an opportunity. Machinery deals are getting better all the time, land prices are falling and in my estimation, will be lower still over the next couple of years. So for those who believe now isn't normal and that there will be a turn around, now is an opportunity to acquire land and equipment at lower prices.

CROPPING PRACTICES

To plant or not to plant? With cash flow problems, debt to service, as long as you can get back your cash costs plus, you plant. What's over and above the cash costs, goes to service the debt. Those with no debt problem and still with crop in the bin will undoubtedly be summerfallowing more in 87 than in 86. If they are like me, it will be the land on which the quack grass is the worst. I also hear some talk among farmers of sowing some of their poorer land down to forage. Coming back to the summerfallow question, if commodity prices continue to fall and input costs don't, summerfallow may become the only economic alternative in the short run. Added to this, if in the next year Canada has to look at some form of short-term reduction in production, it seems to me summerfallow may be a "necessary evil" part of that program.

Question - What to Plant? Answer: What will sell. What is resistant to tan spot, septoria, fusarium head blight? It appears to me there will be more interest in the special crops, forage seed production and in flax and canola. For the two reasons: (1) they can be moved. (2) they do provide a break in the rotation that should disrupt the disease cycles of tan spot, etc., that were so bad in the cereals last year, particularly in the durum wheats.

FERTILIZER INPUTS

This fall our area saw a switch back to NH3 by many of those who had gone to liquid or dry formulations. Why? Because it was 2 - 3¢/lb on N cheaper. I don't plan to cut back my fertilizer application per acre, but I do plan to cut back the number of acres I fertilize. As I said before, we plan to summerfallow some where for the last few years we've had virtually none. We may even sow down some forage on our poorer land and concentrate on the more productive land. I'm sure I can produce bushels more efficiently on my better land. We band all our fertilizer as it seems that method is most efficient when your operating at relatively low fertility levels such as we do.

CHEMICALS

If 2-4D and the rest of the phenoxys bite the dust as is rumoured, maybe all chemicals will be banned and I won't have to spray! I hate spraying. Seriously, I can't farm without chemicals, at least not employing the practices I'm presently using. Broad leaf weed control is a must. However, for grassy weed control, we have switched from blanket pre-emergence spraying to spot treating post-emergent. I don't like it better from a weed control point of view, but it is more cost effective so we use it.

MACHINERY PURCHASES

As I said before, machinery deals are good and getting better. If you've got the money, some excellent buys can be made. However, in the past, most time when we bought a machine a big part of the decision was the tax implications (investment tax credit), not whether the machine was worn out or not.

In fact, with proper maintenance, it's surprising how long they will last. Now with both investment tax credits and taxable farm income being phased out, it does not bode well for farm machinery sales. Its called living off depreciation.

CULTIVATION PRACTICES

Less tillage means less fuel, means less expense, means more profit provided yields don't suffer. And here, in my opinion, the most important factor is seedbed preparation. If you don't get the crop off to a good even start, what you do with it after doesn't matter. It is destined to failure. That happened to a number of crops in our area this year. Green kernels at harvest time, storage problems, grading problems. So while we are reducing tillage, I haven't had big savings in this area as heavy crop residue interfers with seedbed preparation in many cases.

LAND RENTAL OR PURCHASE

Cash rentals where arrangements have been made, seem to have dropped by one-third. Last year in our area, one year agreements were for $25-$30/acre. Now they run from $10-$20/acre. Many arrangements have been switched from cash rent to the traditional crop share arrangement. This illustrates the change in philosophy of the farmer. On cash rent, the better the crop or the better the prices, the more he can make. On crop share, the poorer the crop or the lower the price, the landlord shares the loss.

In the short run, I'm still bearish on land. Land values in our area have fallen from $400 - $425 per acre value in 1985 down to $300 - $325 per acre value in 1986 - with not much land changing hands.

Prospects for 1987 are for further reductions in values. However, I suspect there will be even less changing hands. We get into an interesting argument here among farmers as to whether credit institutions should be allowed to hold onto land which they have foreclosed on. I'm somewhat surprised at the number who say "no", let the land go back on the market and let it drive the price of land down. It's overvalued anyway and that's been part of the problem. Then of course, there is the other side of the argument - that's my equity, my life savings your talking about. If you force land value down, that will make my operation uneconomic and I'll be the next to go. Then the whole thing snowballs.

I guess that for those who do have some money put away and who have a little faith in the future, these times will provide an opportunity to acquire land at relatively inexpensive prices. History will tell us whether it was a good deal or not. Remember they aren't making anymore land.

II. The second broad area I would like to touch on in terms of my reaction, is that of government policy. Firstly on the Federal scene.

WESTERN GRAIN STABILIZATION

You know the program that acts like the old PFAA only in reverse.

You have a good crop, pay into your maximum. Some other area has a poor crop and can't pay in, that triggers a payout. Then you collect and he doesn't. Don't get me wrong, the program has been rather good to Manitoba. It started with my putting one dollar in the pot and the government putting in two. It collects interest and someday I get it all back. It sounded like a good investment. Well we've got it all back now, the pot is empty and it looks like next year may trigger the largest payment ever.

I'm a little hesitant to speculate on how big the payment will be, but surely I can come as close as most of the forecasters of this last $279 million payment - next year $900 million provided we're not left with a lot of wheat in the bin come July 31, 1987. The payout triggering mechanism will be net price per tonne, with the unknown being how many tonnes of this crop can be sold. There will, I'm sure, be changes made to the program with the fund now in a deficit position and a large payout coming. It will probably be looked at in the following areas:

- producer vs government contributions
- $60,000 ceiling on which contributions are made
- involvement of more producers in the fund

TWO PRICE WHEAT SYSTEM

Friends of mine who farm in Eastern Canada love it. They are selling wheat to the flour mills at $71/bus provided the quality is good. Seed processors in Manitoba for the last two years have been shipping seed Katepwa and Columbus which last, to be sown there to cash in on this domestic wheat market. They even have a semi-dwarf spring wheat called Max that is supposed to be equal in quality to our hard red springs. It was licenced as such as I guess it must be so.

Less than 20% of the wheat grown in Western Canada goes into the domestic market and that share is shrinking as eastern growers continue to fill more and more of that market. The higher you put the domestic price, the more the incentive for the eastern grower to switch into wheat. Perhaps in times of low world prices, western wheat growers might be better served with correspondingly lower domestic prices and maintain our share of its domestic market.

DEFICIENCY PAYMENTS

Let me say off the top, most farmers are independent businessmen and as such do not like government giveaway programs and all the publicity that goes with them. However, in light of the present economic situation, unless we wish to have some dramatic changes occur in the grain sector, they are necessary. Its been interesting, to say the least, watching the different farm organizations all across Canada line up and present their case for a piece of the one billion dollar payment, which was originally slated for Western Canada. Everyone has a formula which is fair and which ensures that their particular cause is well served. One thing both Western and Eastern Canada have in common is Ottawa unfortunately for us, is in the east. If you're not there protecting and promoting your interests, your going to lose. We're doing our best - hopefully it is enough.

ON THE PROVINCIAL SCENE

Keep in mind my initial remarks with regard to Manitoba. In the last couple of years, lower prices have been partially offset by good yields and good grades. This year, the price drop is too great to be offset by high yields. The hurt will be felt in our grain sector. Farmers in Manitoba are well aware of what is being done in both Saskatchewan and Alberta to aid their farmers. Things like 6% money on $25/acre loans, rebates on fertilizer, farm fuels at 10¢ per litre, prices, etc. We are also aware that this province does not have the economic wealth of either Saskatchewan or Alberta. However, that is not to say something can't be done. I'm not talking about gifts, I'm talking about correcting things that are unfair and costly to farmers. Things like education tax on farm land. Every study done on the matter has recommended it be changed. Let's get it done.

Purple fuel for farm use. The province does not charge tax on fuel used for farming. Take diesel fuel for example. The tax forgiveness is 9.2¢/litre. It would seem logical that the cost of fuel to farmers would be 9.2¢/litre less than for regular clear diesel fuel. Not so. The tax forgiveness does not get fully back to the farmer. It seems to me, between the farmers and the government, we can work out an arrangement that would be satisfactory to both of us.

I guess its time for the government of this province to show a little support for Agriculture.

Tough times have come and gone in the past and this time will be no exception. There is a saying - tough times don't last; tough people do.

MANAGEMENT CONSIDERATIONS

Irvin Wiebe, Farm Management,
Manitoba Agriculture - Morden, Manitoba

Introduction:

There is no doubt a great deal of pessimism prevelant in the farming community today. In the grain producing sector, falling grain prices and high production costs have resulted in a cost price squeeze, that for many has become unmanageable. Many farm families cannot service their immediate debt obligations. Current grain prices do not support long term debt committments, allow for machinery replacement and provide for a reasonable standard of living. The inability to service farm debt is stressful to say the least. Prolonged stress causes physical, emotional and mental health problems that are becoming increasingly more evident.

Background:

Dr. Clay Gilson has already provided some background outlining some of the factors resulting in the current depressed environment. Let me just briefly summarize a few events leading to this present environment.

Following a lengthy period of burdensome grain stocks and depressed prices in the late 1960's; greatly improved profit margins returned in the mid-1970's. It was a time of rising net income, rising asset values and rising expectations. It seemed that only an outdated rail transportation system could limit the opportunities for a new-found prosperity. A hungry world was counting on a new generation of young farmers to meet the challenge of food production.

The 1980's struck with vengeance. Drought, frost, disease, inflation, high interest and energy costs were quickly eroding high expectations. Grain inventories were again building up and prices falling down. The price of #1 H.R.S. wheat fell from $222.00 per tonne in 1980-81 to the present initial price of $130.00 per tonne. Net farm incomes of Manitoba farmers followed much the same pattern. And so today, we are again looking for answers to questions we hardly understand.

While much of the plight of the present situation has to do with factors outside the control and outside the fencelines of the farmer, there are management considerations that cannot be overlooked by the farmer.

Management Considerations:

It has been said that: "excessive profits are the breeding ground for poor management". If that is the case, there is no doubt that today the profit margins demand the very best management. Survival will depend upon how well the farmer can position himself in the marketplace. In other words, whatever can be done to squeeze a few more dollars of profit out of the business cannot be overlooked. Let's now look more specifically at some of these aspects of good management.

a. Production Considerations:

Since the farm income is still a function of quantity times price, crop selection is a major management decision that affects profitability.

Paper presented by Irvin Wiebe, Farm Management, Manitoba Agriculture to the 1986 Agronomist's Conference, December 10, 1986.

Crop selection is also the single most important marketing decision farmers make all year. More about that later.

A study recently carried out in Alberta has shown that most farmers spend less than two hours per year in crop and variety selection. Selecting a suitable crop, variety and rotation that will perform best on a particular farm, yield the highest net income, and can be sold quickly is a key consideration. A well researched information network can be most beneficial in crop selection and production decisions.

b. Economic Considerations:

Certainly no one would argue that relative to current grain prices the costs of production are high. And while some costs such as fertilizer have moderated more recently it is unreasonable to expect substantial cost reductions for other input costs.

The concepts outlined in the intensive crop management (ICM) philosophy certainly are valid. Every management input must be carefully accessed and applied. The type, level and timing of input costs are critical and must be assessed relative to the anticipated yield response. Certainly lower grain prices affect a manager's decisions with respect to the application of input costs. Some of the time tested economic principles relating to the economics and costs of production must not be forgotten in the decision-making process.

Preparing a detailed crop plan, outlining the costs of production can also be a valuable planning tool. It is important to consider each input cost, looking for areas where costs could be reduced without significantly affecting net income.

Some budgeting at this time can also be beneficial in assessing a variety of management decisions such as equipment leasing vs. buying, additional land rent, minimum tillage, etc.

Once a satisfactory plan has been prepared the plan must be implemented. Carefully monitoring the actual cash flow relative to the projected cash flow will be time well spent. Simply put ... plan the work and work the plan! Financial control is an important function of good management.

c. Marketing Considerations:

Marketing is one of the most important considerations. In fact, it is the best place to generate increased income without increasing the costs. We have already mentioned the consideration of crop selection as the most important marketing decision made all year.

Maximizing the profit from the crop selected brings us to the next topic of grading. Obtaining the best possible grade for the grain farmer's produce is the objective. The historical economic loss for even one grade loss is significant. For example the five year average loss in selling a #3 H.R.S. wheat as opposed to a #2 grade is $9.82 per tonne. While it is not always possible to upgrade a sample, blending and obtaining the correct grade before delivery can be rewarding, especially in years of poor crop quality.

Following the production and grading of a farmer's grain he must choose the best means to get it to market. This will often involve a different strategy for each grade and type of grain. The plan may involve the local feed market, crushing plants, non-board and C.W. Board as alternatives. Producer cars, dealer cars and trucking have also been very profitable marketing alternatives.

c. Financing Considerations:

The current economic environment has some major implication with respect to financing as well. Given the present grain prices it will be difficult to demonstrate a positive cash flow. Financial institutions will be forced to take a very critical look at each line of credit application before approval will be granted or refused. This being the case, considerable time and effort will have to be expended, in preparing a credit proposal. Certainly accurate records are essential in supporting a credit proposal. Farmers will have to spend the necessary time in working through each financial statement. Careful planning and realistic projections will be required.

In tough financial times it is equally important to maintain a good open communication line with lenders. If plans change, these should be discussed before further action is taken. Your lender is a partner in the business. He does not want to be kept in the dark. Above all, he wants your best effort, trust and confidence. A farmer's financial concerns are also the lender's concerns. Implementing a sound financial strategy that will reduce risk will be in everyone's interest.

And finally, while there is so much bad news, it is also important to work at a positive mental attitude. Agriculture will survive, and there is a future in farming. To be sure, the present environment is demanding the very best in farm management. The skills learned now will serve us well in the years to come.

Manitoba **Agriculture Policy and Program** Thrusts

Paper Presented to
1986 Manitoba Agronomists Conference

by

Craig Lee
Assistant Deputy Minister
Policy and Economics Division
Manitoba Agriculture

In response to the negative economic circumstances of the past six years, Manitoba Agriculture programs and policies have focused on keeping the farmer on the land.

Various programs have been implemented to maintain family farm viability.

Several Manitoba Agricultural Credit Corporation initiatives have been designed to cushion the impact on farmers of high interest rates and burdensome debts as follows:

- Interest Rate Relief Program -- $12 million, one-half forgiveable and one-half interest free for two years.
- Operating Loan Guarantee Program -- $100 million commulative total over three years of operating credit provided.
- Interest Rate Reduction Program -- interest rate on regular MACC loans reduced to 8% for 1984-85 and 1985-86.
- Comprehensive Refinancing Program -- $20 million available at 9.5% to refinance farmers in financial difficulty that can become viable by refinancing at a reduced rate.

In tough economic times, the level of management capability is a crucial factor in determining farm survival. Thus the Department initiated a major effort of farm management upgrading to improve farmer decision making in terms of both production and financial management.

Income stabilization programs have been put in place to maintain the viability of farmers directly and the packing industry indirectly. The hog plan required $10.8 million of government funds and has been terminated with the establishment of an acceptable national plan. Beef producers have had a cash injection of $53.9 million over four years.

In my opinion, these programs have contributed significantly to helping farmers stay on the farm and producing hogs and beef. Manitoba hog marketings have increased from 1,172,000 head in 1980 to an estimated 1,550,000 head this year. Manitoba origin cattle slaughter has also increased from 271,000 head in 1980 to an estimated 295,000 head in 1986.

The advent of world trade wars have added a further negative dimension to farm income problems and the future prospects for farm viability.

In response, priority action is being taken to intensify departmental efforts to assist the farm family in working as a management team, and to broaden assistance in the form of addressing the human and social needs of the farm family in coping with their difficult situation.

More specifically, this calls for a shift in programming to:

1. Provide more comprehensive help to deal with family stress by mobilizing field staff (Agricultural Representatives, Farm Management Specialists, Home Economists and other governmental and non-governmental resources) to counsel farm families on economic as well as social problems associated with a family successfully operating a farm.

2. Provide technical assistance to help farmers reduce costs while at the same time maintain productivity. This should not be taken to mean that Manitoba grain farmers can survive simply by improving their efficiency. Manitoba farmers are already amongst the most efficient in the world. Their survival will depend on receiving sufficient government support to offset the support given competing grain farmers in other countries by their governments.

3. Make the Manitoba Farm Debt Review Board operational as soon as possible so that those in most acute circumstances have the benefit of fair treatment and an opportunity to restore their farms to a viable state. A budget of $6.5 million has been provided to enable financial arrangements that will keep the farmer on his land and to administer the Board.

4. Sustain current initiatives with farm groups to maintain soil productivity through erosion control and drainage.

Structural Changes within Manitoba Agriculture

The Department is faced with the need to respond more effectively to the farm financial situation with ever decreasing financial and human resources. These needs will require coping with shifts within and down-sizing of various aspects of Manitoba Agriculture.

It will mean a continued shift of staff from the more technical side of the Department to the financial and human support areas. It will mean the elimination of various traditional forms of assistance or activities which do not hold the same priority as the farm financial issue.

It will mean formulating new ways of providing service to the public at lower cost, while at the same time trying to maintain the quality of that service.

The Department will be following an evolutionary approach to the changes necessary to meet the new needs and challenges. As had already been indicated, this process started some time ago and more of the same type of redirection of resources can be expected.

RESPONSE OF WHEAT TO SEEDING DATE

- Brian Andrews,
Regional Agronomist,
Carman, Manitoba.

OBJECTIVE

1. Observe wheat yields reported by seeding date.
2. Look for Regional differences.
3. Look for varietal differences.

The data used for this presentation comes from the Manitoba Crop Insurance Questionnaire data base. All insureds are asked to report acres seeded for all crops, dates seeded, yields, plus many other items.

This paper looks only at wheat for the years 1981 to 1985 inclusive. The sample size varies from 20 to 25 thousand fields per year. The acres involved ranged from 1.3 to 1.9 million. This represents 38% of the total wheat acres in the province, over the 5 year term.

The data base is designed so one can draw out yields by many factors. For this paper, factors were yield, seeding date, province, region and variety.

Seeding dates are slotted into groups, not individual dates. In the data shown, these are all April, first week of May, second week of May, 3rd week of May, etc., to the 1st week of June.

Over the 5 years, the average number of fields for each date was:

April	2,319
1st week May	5,020
2nd week May	7,808
3rd week May	4,770
4th week May	2,310
1st week June	750

LIMITATIONS

When looking at interactions involving several variables, the sample numbers begin to get low enough to cause concern. For this reason, the information for the first week of June should be treated with caution. It is presented only for interest sake.

Only Central and Southwest are used for the region by variety and date comparisons; other regions do not have sufficient numbers for this detailed a breakdown.

The regions mentioned are administrative regions, not cropping regions.

They approximate:

Southwest	Crop Districts 1, 2 & 3
Northwest	Crop Districts 4, 5 & 6
Central	Crop Districts 7 & 8
Interlake	Crop Districts 11 & 12
Eastern	Crop Districts 9 & 10

As with any study, the yearly climatic factors can be of great significance. Southwest has a series of drought years in the 1980's and this can confound the issue of trying to look at a provincial or regional situation.

Rapid changes in varieties makes long term comparisons difficult - i.e. Katepwa acres in 1984 = 68,000 and in 1985 = 618,000. The data selected was a 5 year term, however, for new varieties, one has to look at 3 and 2 year data to get valid comparisons.

ALL PROVINCE, ALL WHEAT

The 5 year all province, all wheat data provides a typical expected curve that shows reducing yields as seeding date is delayed (Figure 1). The provincial average yield drops from 37.7 bushels/acre to 28.3 for the 1st week of June.

The 5 year all province variety data (Figure 2) indicates all 4 varieties decline in yield as seeding is delayed. Glenlea was highest yielder at all dates. Neepawa and Benito are close for the first 2 dates, then Benito shows a slight advantage for later seeding. Sinton is lowest yielding, and when expressed as a percentage of Neepawa is less than the Field Crop Recommendations (FCR) indicate. It yielded 80 to 85% of Neepawa, where the FCR indicate 97%.

A 2 year period must be looked at, to see the newer varieties (Figure 3). Columbus yielded slightly less than Neepawa as the FCR indicate. Katepwa yielded higher than would be expected. It is the highest yielding red spring at all dates and approached Glenlea in the last 2 weeks of May. Katepwa as a percentage of Neepawa was 108% to 114%.

REGIONAL INFORMATION - ALL WHEAT

The next step, after looking at the provincial data, is to look at all wheat by regions, to see if any differences appear (Figure 4). Central Region most closely represents the provincial trends due to sample size. There is a consistent drop in yield from first to last date of seeding (41.3 for April to 34 for M-4). Southwest remains fairly constant from April to May 3 (32.9 to 30.8 bushels/acre). Eastern Region follows a trend similar to Central. Northwest and Interlake differ, in that the yields peak in early May.

Figure 5 shows the percent of reported all province acres seeded by date, for the 5 year term. In all years, over 90% of the acres were seeded by the end of May. 1985, 1984 and 1981 were years that close to 80% of the acres were seeded by the end of the 2nd week of May. 1983 had an extended seeding period and you will see later, that it was also the lowest yielding year of the 5 under consideration.

The next series of figures show the year to year variability for all wheat within each region. It becomes obvious that year to year differences are often greater than any seeding date within any one year. Some years show very little response to seeding date, while others, usually high yielding years, show some large bushel differences with seeding dates. The high yields in 1985 reflect not only an excellent red spring wheat year, but also over 220,000 acres of semi dwarf wheats.

Central Region All Wheat (Figure 6)

1985 and 1982 were the high yielding years. 1981, 1984 and 1985 show typical expected response to seeding dates. 1981, 1982, 1984 and 1985 show large responses to seeding dates from April to the end of May. This trend is similar to several other regions. The data shows the large difference that years can have. For April seeding, 1983 yielded 32 bushels and 1985 yielded 54 bushels. The high yielding year 1985 also shows large declines in yields - 54 bushels in April to 42 for 4th week of May.

Southwest Region All Wheat (Figure 7)

1985 and 1982 were high yielding years. 1985 resulted in an expected yield drop with seed date. 1982 did not give normal responses to seeding dates. Yields were relatively constant from April to 4th week of May.

Northwest Region All Wheat (Figure 8)

Northwest data indicates a general trend for maximum yields in the first week of May. Similar to other regions, 1982 and 1983 did not show large differences during the bulk of seeding (1st week of May to 4th week of May). 1981 and 1985 were the high yielding years.

Eastern and Interlake All Wheat (Figures 9 & 10)

Sample size creates a problem in looking at these 2 regions. Each region represents less than 90,000 acres. Extremes in yields versus seeding dates result from low sample numbers. Considering these limitations, it would appear that in highest yielding year (1985), the trend is for maximum yield for April seeding. For other years, it appears that early May was the preferred seeding date.

Table 1 **5 Year Regional Average - All Wheat**

	Southwest	Northwest	Central	Eastern	Interlake
April	32.9	32.4	41.3	38.5	33.7
May-1	32.1	34.6	40.6	37.0	34.3
May-2	31.6	34.1	38.9	31.9	32.5
May-3	30.8	33.0	37.0	29.4	29.1
May-4	29.1	31.4	34.0	24.8	27.5

VARIETY BY REGION, BY DATE

Only Southwest and Central Regions are considered for this section. Anomolies show up in the June-1 date. This is due to low sample numbers.

5 Year Data (Figures 11 & 12)

All 3 varieties show decline in yield as seeding was delayed in Central Region. Benito shows an advantage over Neepawa in the last part of May.

Southwest indicates a relatively constant yield up to the 3rd week of May for red spring wheats. Benito and Neepawa are similar until the last week of May, when Benito shows a slight advantage. Glenlea peaks in the first 2 weeks of May.

3 Year Data (Figures 13 & 14)

In Central Region, Columbus has a peak in the first week of May. Other varieties peak with the earliest seeding date.

Southwest Region once again peaks in early May for most varieties. Columbus yields decline from April seeding to the 4th week of May. Neepawa reacts similarly and yields basically the same as Columbus until the 4th week of May.

2 Year Data (Figures 15 & 16)

Two years' data is a short time period to draw any conclusions. This information is provided only to give an indication of how Katepwa has performed. Katepwa has caught on very fast and represents the largest acreage variety of red spring wheat in 1985.

Central Region data indicates Katepwa equal to Neepawa for April seeding. As seeding is delayed, Katepwa gains on Neepawa. Both varieties show decline in yield as seeding is delayed.

Southwest Region data shows Katepwa outyielding Neepawa at all seeding dates. As seeding was delayed, the advantage of Katepwa becomes greater.

HY320 (Figure 17)

Semi dwarf wheats enter the picture about 1983. The acres went from 86,000 in 1984, to 228,000 in 1985. Although HY320 did poorly in 1986, it represented the largest acres for any single variety 1984 to 1985. On an all province basis, the data base indicates a significant response to seeding date. April seeding resulted in 60 bushels/acre and 4th week of May resulted in 48 bushels/acre.

SUMMARY

Regions differ in response to seeding date.

Year to year climatic effects are often greater than seeding date effects within one year.

Largest yield differences in seeding dates occur in high yielding years and with high yielding varieties.

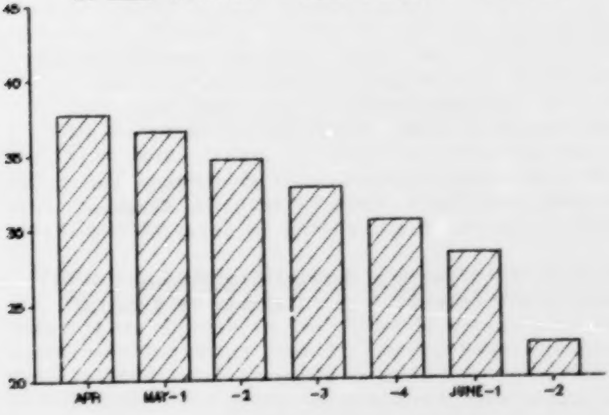
There are varietal differences, Benito better than Neepawa for late seeding.

Rapid changes in variety distribution make long term observation (and research) difficult.

Based on the 5 years under study, Central and Eastern wheat yields decline from April seeding to the 4th week of May. Southwest shows a similar trend, but yield differences are small. Northwest and Interlake peak in the 1st week of May.

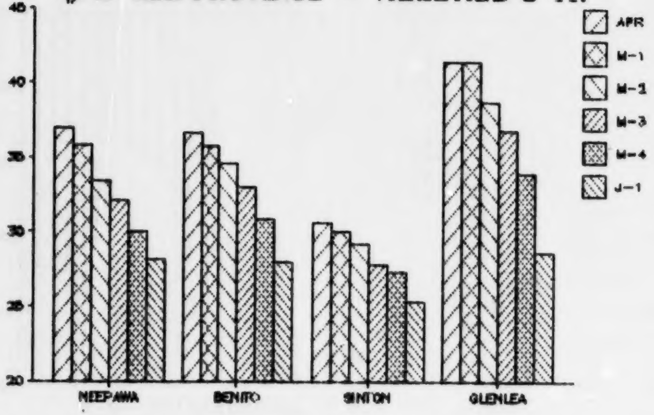
Acknowledgements

Thanks to T. Last and H. Nelson of Manitoba Crop Insurance Corporation and J. Epp of Manitoba Agriculture's Computer Services.



1. ALL WHEAT - ALL PROV - 81-85

2. ALL PROVINCE - VARIETIES 5 YR



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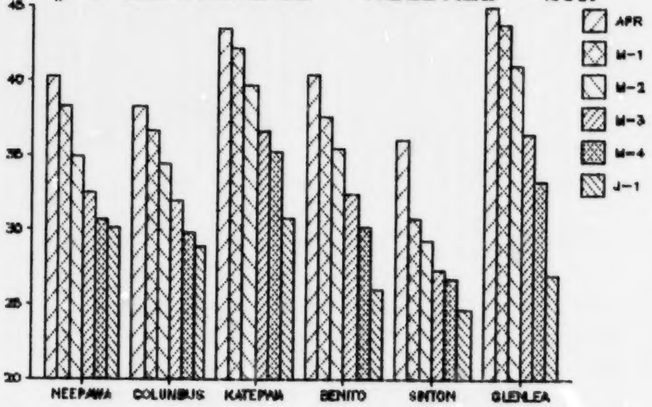
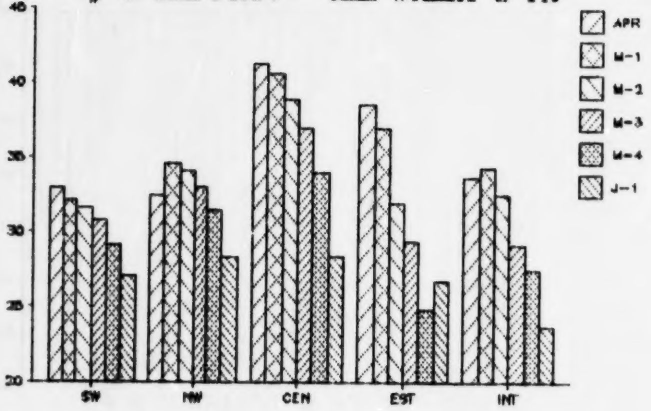
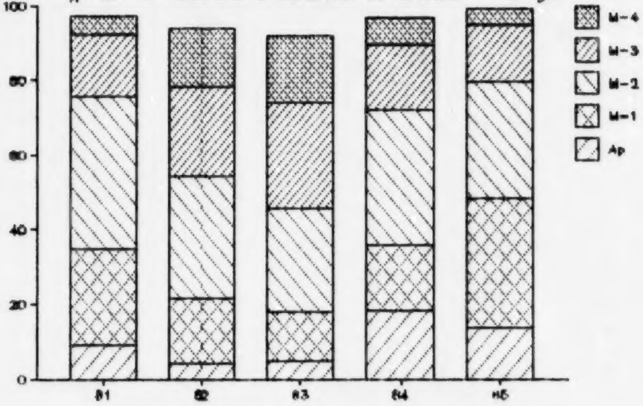
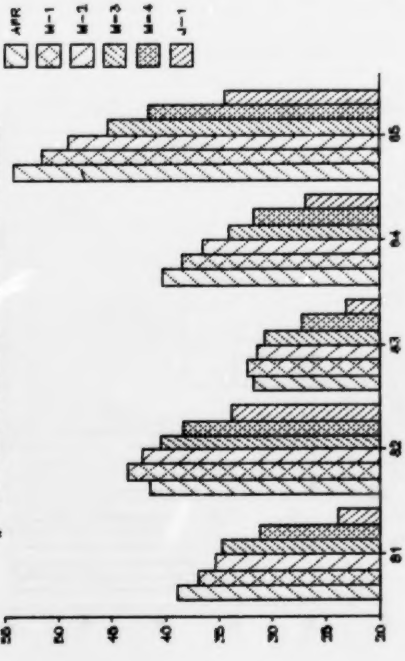


4. ALL PROV - ALL WHEAT 5 YR

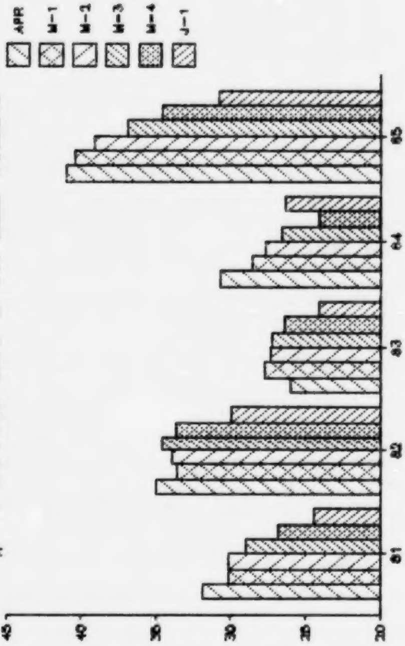


5. % Acres Seeded X Date - 5 yr

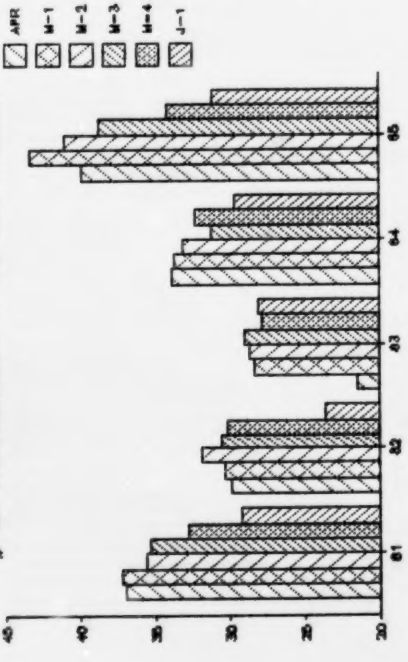




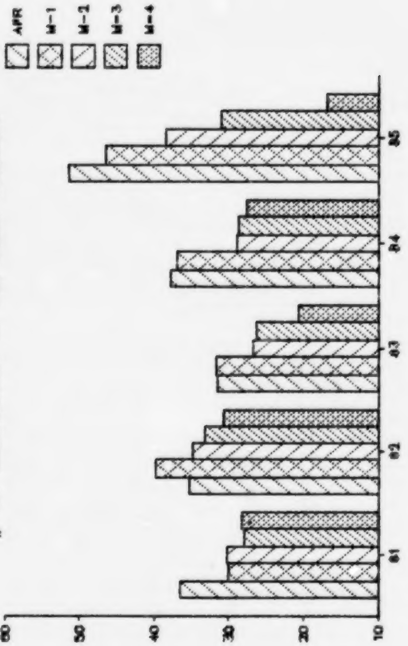
6. CENTRAL 5 YR ALL WHEAT



7. SOUTHWEST 5 YR ALL WHEAT

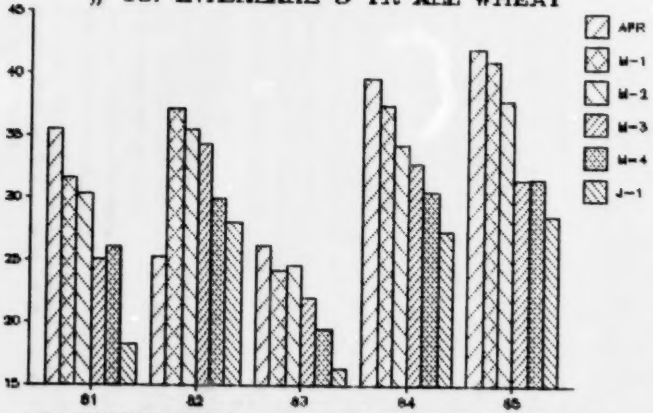


8. NORTHWEST 5 YR ALL WHEAT

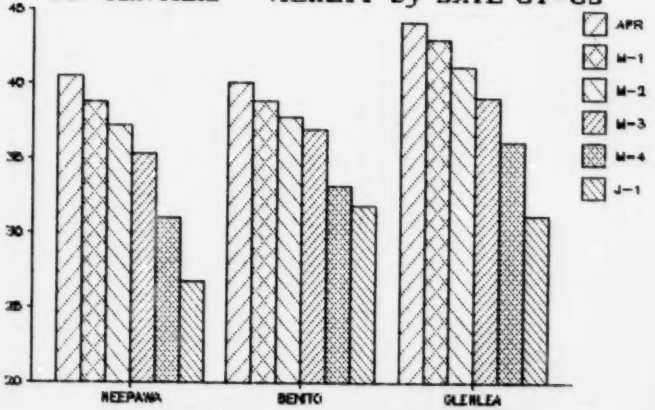


9. EASTERN 5 YR ALL WHEAT

10. INTERLAKE 5 YR ALL WHEAT



11. CENTRAL - VARIETY by DATE 81-85



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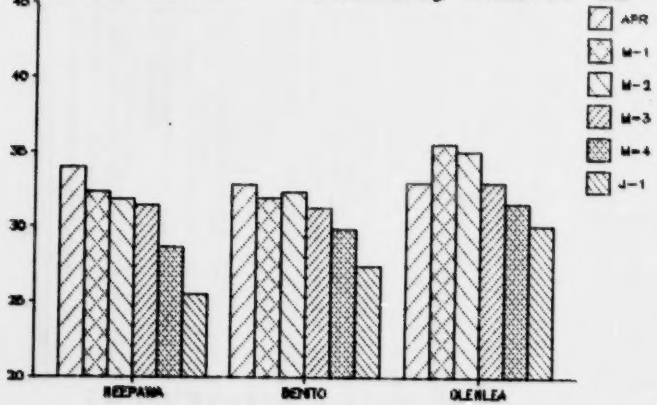

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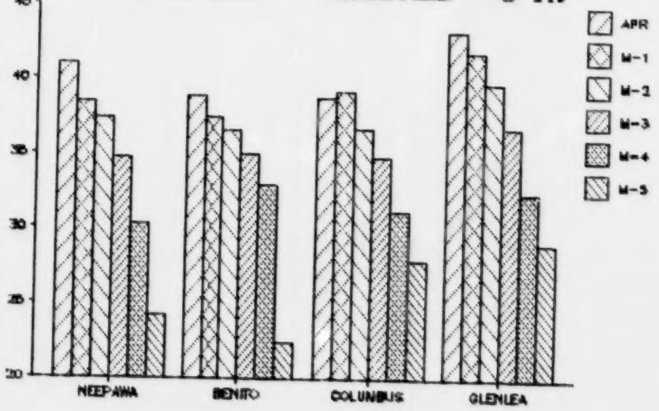
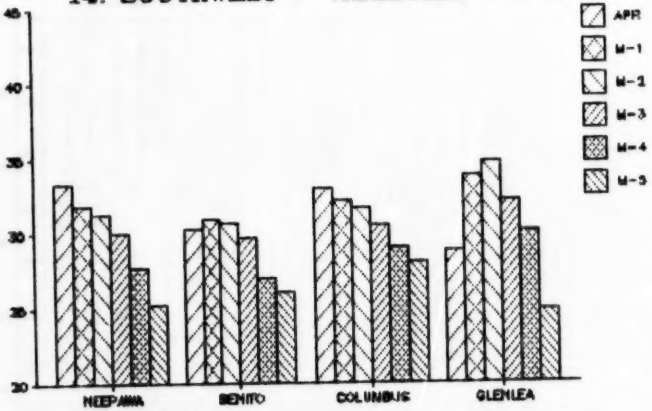


14. SOUTHWEST - VARIETIES - 3 YR



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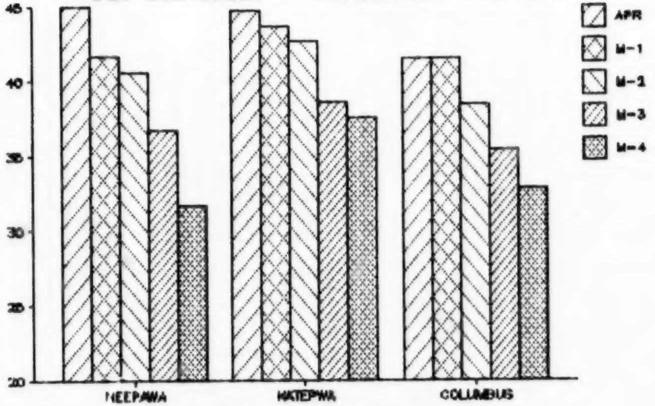
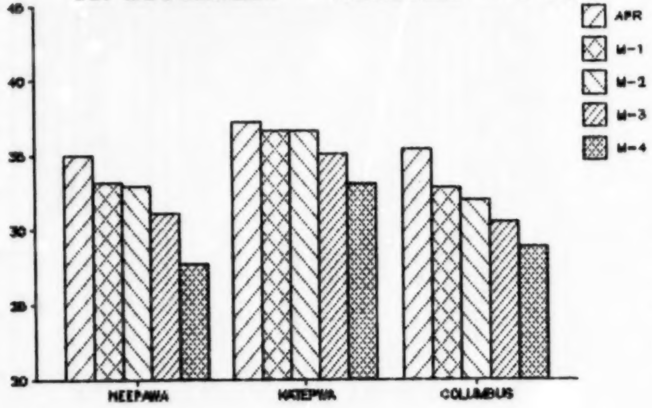
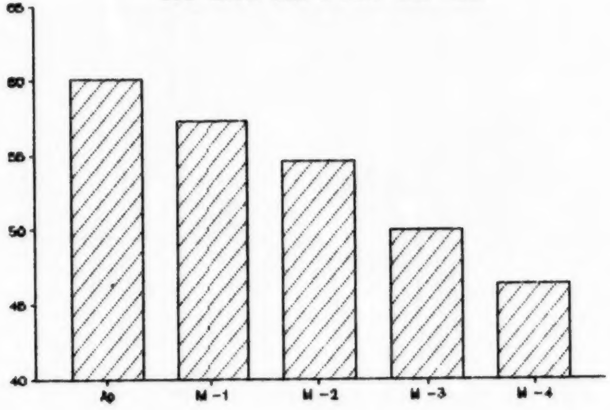


16. SOUTHWEST - VARIETIES - 2 YR



HY 320 All Prov 84-85



DEVELOPMENT OF AN EARLY BLIGHT FORECASTING SYSTEM FOR POTATOES

B. GEISEL

INTRODUCTION:

The principal foliar disease of potatoes in Manitoba is early blight. The Alternaria Solani spores, which cause early blight, overwinter in potato debris and are spread by wind to new plants in spring and early summer. These spores germinate and fungus penetrates the lower leaves of the plant to form lesions. (1,2) From mid-July through September new spores form on the lesions which will re-infect the host or spread to other potato plants (3). Disease development and severity is dependent upon the presence of the pathogen in potato debris, a susceptable host and favorable climatic conditions (wind, high temperature and leaf wetness) which will facilitate the germination and spreading of spores.

Early blight can be controlled by crop rotations which will reduce the guantity of initial innoculum or fungicide sprays which reduce the secondary infection. The current recommendations are to begin fungicide sprays when the potato plants are 15 to 20 centimeters high and continue spraying on a 7 to 10 day interval throughout the season, regardless of the environmental conditions.

The fungicide program, like the one described above, has many drawbacks. First, it is very costly when a fungicide is applied without knowing that any given application is necessary to control disease or prevent yield losses. A single application of fungicide costs 21.08 $/ha (9.92 $/ha for fungicide + 11.16 $/ha for aircraft application). These costs may vary with the fungicide and application method used. Secondly, urban consumers have an image of farmers using pesticides indiscriminately and based on this image they pressure government to withdraw the registration of chemicals which may persist in the environment and cause health problems. The above mentioned fungicide program does nothing to enhance the farmers reputation with the urban consumer or reduce the risk of pesticides appearing in foods or in the environment.

For the past two seasons the Keystone Vegetable Producers Association Agri-Food project has been testing an early blight forecasting computer program called F.A.S.T. (Forecasting Alternaria Solani on Tomatoes). If F.A.S.T. should prove effective in controlling early blight with fewer fungicide applications then it will assist growers in dealing with the new economical and social conditions affecting pesticide use.

The F.A.S.T. program, which was developed by Madden, Pennypacker and McNabb (4) at Pennsylvania State University, uses two known models to determine periods when environmental conditions are favorable for early blight disease development. The models depict the relationship between the microclimate in the potato canopy and the organism which causes early blight.

Model 1: The hours of leaf wetness and mean air temperature during leaf wetness are combined to derive daily severity (S) values. The S values increase as the duration of leaf wetness and mean air temperature during leaf wetness increases. The S values are used in two ways:

a) fungicide applications are initiated when the total severity value (addition of S values from date of crop emergence) equals 35.

b) fungicide applications after initiation are recommended whenever the cumulative severity value (addition of S values for the past seven days) exceeds a selected value.

Model 2: Daily severity rating (R) values are calculated from air temperatures, relative humidity and total precipitation. When the R value exceeds 9 than a 5 day rather than a 7 day interval between spraying is recommended. In the four years that the F.A.S.T. program was tested (*) under Manitoba climatic conditions the R value never exceeded 9, so this model has been ignored and excluded from the program.

The objective of the 1986 Agri-Food field trial was to compare the yield, quality and incidence of early blight between field plots of potatoes that were sprayed on a fixed 10 day fungicide schedule (according to accepted farming practices) and the F.A.S.T. system of scheduling fungicide applications.

PROCEDURE:

Four test locations were selected and a weather station which included a rain guage, leaf wetness sensor, hygrothermograph and a non-volumetric spore trap were set up. The hygrothermographs were housed in a Stephanson screen, which was mounted 20 - 30 cm. above the ground.

At each location part of the field was split into two plots. One plot received fungicide applications according to accepted farming practices. Generally fungicide applications started in the first two weeks of July and continued on roughly a 10 day interval until the end of August or early September.

On the second plot the date of initiating fungicide applications was based on data from the spore traps (see figure 1). Spraying was started when a significant rise in the spore count occured. Plot spraying after initiation was determined when cumulative severity values (addition of S values for the past seven days) reached a predetermined threshold value. In past field tests with Russet Burbank a cumulative severity (Cs) value of 14 was used to indicate when spraying was necessary. This threshold value had to be revised for those varieties which are more susceptible to early blight. Cs values of 12 for Shepody and 10 for Norland and Norchip were arbitrarily chosen. These lower Cs values would reflect the varieties greater susceptibility to early blight in the computer program by scheduling more frequent fungicide applications. Details of cumulative severity values and fungicide application dates typical of the four test locations are shown in figure 2.

RESULTS:

On average, the F.A.S.T. program recommended 2 to 3 fewer fungicide applications than that what would normally be applied when using the generally accepted method of scheduling. See figure 2.

The incidence of early blight was determined by estimating the amount of blight on 50 randomly selected plants throughout the test strips. A "blight assessment key" was used to determine the percentage of leaf area infected. There was no significant difference in the amount of early blight between treatments.

* F.A.S.T. was tested for two years by Roger Rimmer of the University of Manitoba and for two years by Keystone's Agri-Food Project.

Figure #1 Spore Counts From Carnation Foods Ltd.

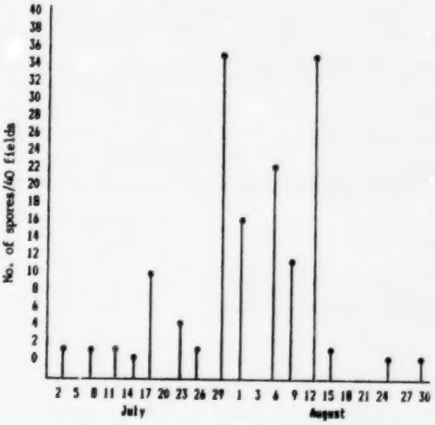
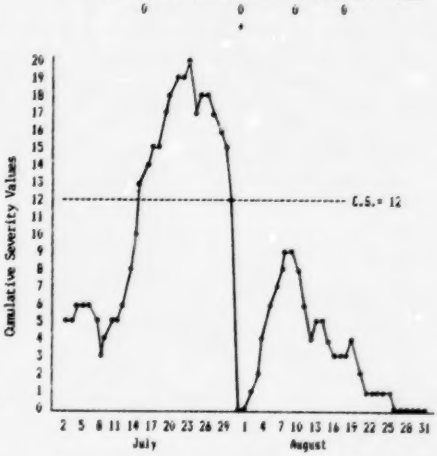


Figure #2 Cumulative Severity Values Calculated from Weather Data Collected at Carnation Foods Ltd. - 1986



* Date of fungicide application on the F.A.S.T. plot.

0 Date of fungicide application on the plot which had treatments scheduled according to accepted farming practices.

Yields were calculated for the test plots at Carnation Foods Ltd. and Hespler Enterprises by weighing and grading a full truck load from each treatment. These results are listed in Table 1. The yields and grades were similar between treatments. At Carnation Foods Ltd. the yield favored the F.A.S.T. program plot. It is my opinion that the difference in yield between treatments at this location was due to variations in the soil type or farming practices and not due to the degree of early blight control.

TABLE 1 Yield Results From Blight Forecasting Trial - 1986

Location	Treatment	Total Yield tonnes/ha	≤4.45 cm tonnes/ha	>4.45≤5.08 tonnes/ha	>5.08 tonnes/ha	≥285gr %	Value/ha[1]
Hespler Enterprises	accepted practices	23.46	0.85	3.40	19.20	28.8	
	F.A.S.T.	23.13	0.56	3.46	19.11	22.0	
Carnation Foods	accepted practices	21.37	0.49	1.46	19.42	28.8	
	F.A.S.T.	23.22	0.22	0.54	22.46	44.8	

(1) McCain's contract formula was used to determine the value/ha tubers >5.08 cm were valued at 115.71 $/tonne.

SUMMARY:

The 1986 field trials were not replicated and spray application timing was not controlled well enough to completely evaluate the F.A.S.T. programs effectiveness in controlling early blight. The F.A.S.T. program appeared to work well in 1986, but under different climatic conditions (i.e. hotter and wetter) it may be less effective. The arbitrarily chosen threshold Cs values, which indicate when a fungicide application is necessary, will have to be tested and adjusted to accurately represent each varieties susceptibility to early blight. Replicated plot testing over several years and climatic conditions will be necessary to rectify these problems.

The 1986 evaluation of F.A.S.T. did demonstrate some important points:

(1) According to the specific weather conditions of 1986 it was not necessary to begin fungicide applications until late July (see figure 1). Many growers did not initiate fungicide spraying before late July.
(2) Growers, who scheduled fungicides according to what is considered accepted farming practices, probably applied fungicides more frequently that was necessary to obtain economic control of early blight.

It is my opinion that the F.A.S.T. program is a more economic and environmentally acceptable method of controlling early blight than what is generally being practiced by Manitoba Potato Growers.

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SULPHUR DEFICIENCIES IN MANITOBA SOILS

K. S. McGill
Manitoba Agriculture
Soil Testing Laboratory

Introduction

Sulphur has, for many years, been recognized as an important consideration in fertilizer management practises for crop production in Manitoba. During the 1960's several cases of sulphur deficiency in rapeseed were identified. Based on data from field research trials, the Manitoba Provinicial Soil Testing Laboratory, in 1973, introduced a sulphur soil test. Over the following years, incidents associated with sulphur deficiencies tended to level off. However, in the 1986 crop year, a significant number of problems in canola suspected as being caused by low sulphur levels were encountered. Analyses of soil and/or plant tissue samples taken from a few of the affected fields tended to confirm these suspicions. In most instances the entire field had not been affected uniformly but problems occured in patches throughout the field. In some cases, fields had been soil tested and no additional fertilizer sulphur had been recommended. Reports have been received of situations where there was an apparent problem in spite of a sulphur fertilizer application. As a result a number of questions have arisen relative to the sulphur status of Manitoba soils and the potential for increases in sulphur problems in 1987 and future years, the reliability of the soil test for sulphur, and the effectiveness of various fertilizer sources.

Sulphur Requirements of Crops and Sulphur Deficiency Symptoms

Of the crops grown in Manitoba, canola, alfalfa, clovers and sugarbeets have the highest sulphur requirements for top production. Cereals, annual legumes, grasses and most special crops including corn, sunflowers and potatoes are intermediate in their requirements while flax and buckwheat have relatively low requirements. Most crops contain about the same amounts of sulphur as phosphorus. The forementioned three groups of crops contain respectively (at good yield levels): > 20; between 10 and 20; and < 10 kg/ha total sulphur in the above ground (and tuber in the cases of sugarbeets and potatoes) portions of the crop.

Under marginal levels of available sulphur, most crops show no obvious visual effects but yields may still be depressed. All crops exhibit deficiency symptoms when sulphur contents are critically low. Canola in particular manifests very obvious and characteristic deficiency symptoms which is why sulphur deficiencies and canola are often associated. This has made it a good "indicator crop" of low levels of available sulphur and helped identify soils and fields with a sulphur limitation which had gone undetected prior to the production of this crop.

Generally, crop deficiency symptoms include: reduced overall growth with spindly plants; paling and yellowing of the leaves (similar to a nitrogen deficiency symptom except that the youngest uppermost leaves are affected first as opposed to the oldest, lowermost leaves as is the case for nitrogen); non uniform and/or delayed flowering and maturity; and reduced nodulation in legumes. Following are deficiency symptoms of some specific crops.

Canola - In the initial stages or under a moderate deficiency situation there is a general yellowing of the youngest leaves which gradually progresses to the oldest leaves. As this advances or under a more severe limitation the leaves tend to be narrow, cupped upwards, stand erect, become "leathery", and develop a pink to reddish tinge on the underside which ultimately becomes purplish and progresses to the upper leaf surface, petiole, stem and pods. The stem becomes woody and the plant stands tall and spindly. Flowering and ultimately maturity is delayed, prolonged and/or erratic. Flowers are paler than normal (almost whiteish in some cases). Pods form slowly and are small, reduced in number and with reduced or no seed set and, where formed, seeds are small and shrivelled. (This later symptom is often the first indication of a sulphur problem and the one most commom encountered in 1986.

Alfalfa - Tillering is reduced. New leaf growth is pale yellow-green and stunted with a reddening of the stem. Individual leaflets stand erect.

Cereals and grasses - General and interveinal yellowing of the leaves occurs starting with the youngest leaves. Older leaves remain green. Tillers stand erect.

Field peas - Leaves on the upper part are small and yellow-green with a reddening of the petiole as well as the main stem at the top of the plant. Internodes are reduced.

Corn - Interveinal yellowing initially affects the younger leaves. This is followed by a redenning of the leaves (starting at the margin) and of the stem. Older leaves remain green.

Sunflowers - Paling of the youngest uppermost part of the plant occurs. The growing point shows the greatest effect often forming a cream colored rosette of the top leaves and flowers. Plant height is reduced, caused by a shortening of the internodes.

Potatoes - General yellowing of the plant coincides with a redenning of the stems and a curling inwards of the young leaves.

Flax - The plant, starting at the top, progressively yellows. The leaves are reduced in size and pressed to the main stem giving an erect appearance.

Sulphur Soil Test

Research conducted in the 1960's and 1970's in Manitoba and throughout Western Canada showed a close relationship between water soluble soil sulphate levels, plant utilization of soil sulphur and crop responses to applied fertilzer sulphur (very similar to the relationship between water soluble soil nitratenitrogen and crop use of soil and fertilzer nitrogen) (1,2). Some studies also found that on soils with very low sulphate levels in the surface but which had higher levels in the subsoil (the kind of gradient in sulphur levels found in many Western Canadian Soils) crops obtained adequate sulphur and did not respond to fertilizer suplhur applications even though in the early growth stages they exhibited classic sulphur deficiency symptoms (2,3). The source of the sulphate at depth is often gypsum which has accumulated 30 cm or more below the soil surface often in association with a Cca or Csa horizon.

These results formed the basis of the sulphur soil test developed and initially offered in 1973 by the Manitoba Soil Testing Laboratory which involves measuring the sulphate content of the soil to the 60 cm depth and providing fertilizer sulphur recommendations based on guidelines outlined in Table 1.

Variability in Soil Sulphate-Sulphur Levels

One of the biggest problems associated with the soil test for sulphur is the extreme variability in the sulphate-sulphur content of soils. Not only do sulphate levels vary with depth in the soil and from field to field and year to year in response to environmental conditions and management practises but they also can differ significiantly between different locations within the same field.

These differences relate directly to the topography of the field and the textural and drainage properties and patterns of the soil in the field since ionic sulphate moves freely in and with water in the soil. In sloping or undulating fields sulphate tends to be lowest in the mid to upper slope positions, higher in the lower slope position and at very high levels in poorly drained depressional areas. Knolls that have been severely eroded may be very high in sulphate if the subsoil that has been exposed or is near to surface contains gypsum. On fields with variable texture and drainage, sulphate tends to be lowest in the coarser textured and/or better drained areas and highest in the heavier textured and/or poorer drained areas.

Table 2 gives an indication of the degree of variability in sulphate levels that have been encountered in fields in Manitoba in which a number of locations were sampled in each field and the samples from each location were analysed separately. It is this kind of variability that gives rise to situations where parts of fields appear sulphur deficient while other parts are unaffected. It is also this variability that creates problems in soil testing where an "average" field sample indicates the presence of an adequate level of available sulphur and no need for fertilizer sulphur where in fact parts of the field are sulphur deficient and do require fertilizer sulphur for top crop production. Sulphate in the samples taken from sites in a field with high available levels may be sufficient to mask the low levels from other sites in the field and bring up the level in the overall field sample to a point above the cutoff where a fertilizer recommendation is given.

To help compensate for situations like this; the Provincial Soil Testing Laboratory prints a comment as follow on all soil test reports where the sulphate-sulphur test levels are in an available category one above that where a sulphur fertilizer reccomendation would have been given (Table 1). "Available sulphur may be inadequate in better drained portions of this field. Sulphur may be applied to ensure an adequate supply". (a rate appropriate to the specific crop is given).

Additionally the guidelines for field sampling provided by the Manitoba Soil Testing Laboratory suggests that samples be taken only from mid slope positions in undulating fields or from the better drained, coarser textured areas of fields. This is an attempt to ensure potential sulphur deficiency problems are detected and, where needed, fertilizer sulphur is recommended to provide adequate available levels for top production over the entire field.

Trends in Soil Sulphate-Sulphur Levels

Summaries of the results of sulphur soil tests from analyses of farm soil samples prior to 1979 (when the test was offered as an option and only performed on a request basis) indicated a steady increase in the percent of fields receiving a fertilizer sulphur recommendation (4). This combined with a continuous increase in demand for the service and significant number of suspected and/or confirmed cases of sulphur deficiencies in crops lead, in 1979, to the inclusion of the sulphur test as part of the package of tests routinely performed on all two depth (60 cm) farm soil samples submitted to the laboratory.

Summaries of the results of tests from 1979 to date are given on an annual basis in Table 3 for the overall province and in Tables 4 to 8 for the various Manitoba Agriculture defined regions of the province. (Data is presented in terms of the percent of fields tested falling into various sulphur "availability categories" based on soil test levels).

Results show that invariably the percent of fields that received a fertilizer sulphur recommendation rose steadily over the period 1979-81 and then quickly declined to reach the lowest level (in most cases) in 1983. Since that time the percent of stubble fields (province wide) that have required fertilizer sulphur has again increased with about 14% of fields falling in the very low to medium categories. In the Southwest and Northwest regions this increase has been steady with a higher percent of fields receiving a Sulphur fertilizer recommendation for the 1987 crop than in the previous year. These are the only regions where the percentage is approaching or exceeding that reached in the 1983 samples. Presently 18% and 16% respectively of stubble fields fall into the very low to medium categories. The increase in the Central region occured between 1983 and 1984 and has since remained steady at about 10% of field in the medium or lower categories. Increases in the Interlake region have been somewhat erratic with a higher percent of field having received a sulphur recommendation for the 1986 crop that for the 1987 crop. In this region 13% of fields in the fall 1986 data are rated medium or lower in available sulphate-sulphur. In contrast, in the Eastern Region, the percent of fields that have received a sulphur recommendation decline to the 1983 year and has since remained relatively constant. Here 7% of fields are rated as very low to medium.

Overall trends in the data from fallow fields are generally similar but are somewhat less consistant. Fallow fields tend to be higher in sulphate-sulphur than stubble fields because, similiar to the situation for nitrogen available sulphate-sulphur is mineralized from the organic matter during the fallow period and accumulates in the soil. Hence the lower percent of fallow fields that have generally received a fertilizer sulphur recommendation. (Considerably fewer samples are involved in the summaries for fallow fields. This is likely the cause of the greater variability observed in the data.

The trends that have been cited in overall soil sulphate levels are very similar over the past 3 years to those that have been observed in soil nitrate levels in the province. Undoubtly the reasons for this are similar. In 1985, high levels of production of most crops which would have used high levels of plant nutrients were generally obtained. During the late summer and fall of 1985, large amounts of precipitation were received over most areas of the province. It would appear that it was sufficient to leach nitrate and sulphate contained in the upper soil after crop growth to depths below 60 cm since levels of both nitrate and sulphate showed a significant decline in data from the 1985 soil test results. Again, relatively high levels of production were achieved in 1986 further depleting soil nutrient levels, particularily nitrogen and sulphur as indicated by data from the 1986 soil test results (5).

Applying Fertilizer Sulphur

Most sulphur fertilizers contain sulphur in one of two forms: sulphate-sulphur, or elemented sulphur. Ammonium thiosulphate is a liquid fertilizer which contains sulphur in a form in which half quickly becomes sulphate the other half finely divided elemental sulphur.

Plants take up sulphur only in the sulphate forms. Hence, Sulphur in sulphate supplying fertilizers can be immediately available to the crop. The method of applying a sulphate fertilizer, (ie: broadcast, incorporated or banded) will not affect the efficiency of use of the sulphur by the crops as long as the sulphate is dissolved and is placed or moves into the root zone when required. Sulphur fertilizer recommendations provided by the Manitoba Provincial Soil Testing Laboratory and Manitoba Agriculture are based on sulphur being applied as sulphate since it is the only form readily available to plants. Sulphur that is applied in the elemental form must undergo oxidation to the sulphate form to be used by the crop. This is a microbial process. The conversion is therefore dependant upon the presence not only of the species of bacteria that are capable of doing this but also on favorite conditions for there activity (ie: moisture and temperature).

Research has consistantly shown that in most soils in Western Canada this oxidation process is not rapid enough to provide an adequate amount of sulphate to meet crop needs in the year of application regardless of the form or method in which it is applied.

In one experiment conducted under ideal temperature and moisture to ensure optimum conditions for bacterial activity, finely powdered elemental sulphur which was thoroughly mixed throughout the soil, did not supply sufficient sulphur for good growth of rapeseed plants. Plants grown in soil that had been fertilized with sulphate sources grew well and contained adequate sulphur levels (6). Perhaps the reason why some crops in the field have shown a sulphur deficiency in spite of a sulphur fertilizer application is that sulphur in the elemental form has been applied and the crop did not subsequently receive adequate sulphur.

Manitoba Agriculture suggests that "Sulphur in the elemental form, as it occurs in some high analyses sulphur products such as flaked or prilled elemental sulphur (99% S), flowers or sulphur (99% S) or granular sulphur (90% S)" "are not recommend to be applied on soils with a low available sulphur content where the crop would require the sulphur to be available in the immediate year of application"

It should be noted that "Ammonium thiosulphate can be applied to supply sulphur at the rate recommended for sulphate-sulphur" since demonstration work (7) has shown it to be as equally effective a source of sulphur to crops as sulphate bearing fertilizers.

Plant Tissue Analysis

Plant tissue analysis is a useful method of assessing the sulphur (or other nutrient) status of a crop. Results of analyses of plant samples, properly sampled and handled as recommended, indicate the sulphur content in the crop which once interpreceded can suggest whether the level is low, marginal, sufficient or high, for top production. This can be helpful in confirming a suspected deficiency.

Since crop content is directly dependant on the supply of sulphur available to it, other factors being favorable, a plant tissue analysis can be a good indicator of the sulphur status of the soil. It also provides a reliable means of assessing the effectiveness of a sulphur fertilizer application and whether or not it has successfully provided sulphur to a crop.

A plant tissue analysis should never be used to replace soil testing, but it can be used to evaluate how well a soil test has indicated the soil levels and whether the recommendation provided was sound.

In certain situations, a plant tissue analysis can be helpful when a suspected deficiency is encountered very early in the growing season. Coincidently taken soil samples will also help to indicate whether the soil is in fact low in sulphur.

If results of the analyses indicate that sulphur is lacking, a prompt application of a sulphate fertilizer that quickly dissolves into the root zone may ensure that the crop recovers with little or no loss in yield. There are unfortunately many soils in which a crop may show a sulphur deficiency early but naturally grow out of it with no reduction in final yields if the roots subsequently penetrate a subsurface supply of sulphur like gypsum. A plant tissue analysis alone would not be able to predict whether this is possible but a soil test would give a good indication of whether or not this potential sulphur supply is present.

Conclusions

Data from the Provincial Soil Testing Laboratory indicate that in all but the Eastern Region of Manitoba the percent of fields that have received a sulphur recommendation has risen over the past few years. In the Northwest and Southwest regions this percent is higher for the 1987 crop than it was in 1986, while, in the Central and Interlake Region this percent is respectively the same and lower. The Eastern region has shown a decline which since 1983 has remained constant.

In order to ensure that crop production is not limited by a sulphur deficiency producers should:

(1) Have soil tests for available sulphur levels run on all fields prior to the growing season, ensuring that soil samples are taken from the best drained, coarsest textured parts of the field or on the mid slope portion of undulating fields and that they are properly taken to the 60 cm depth.

(2) Apply sulphur where recommended using a fertilizer source that supplies sulphur in the sulphate form.

(3) Have a plant tissue analysis and a complete soil test run on crops in any fields that show sulphur deficiency symptoms early in the growth stage and apply a remedial application of sulphur in the sulphate form if warranted.

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Table 1. Fertilizer Sulphur Recommendation Guidelines Used By The Manitoba Soil Testing Laboratory

Soil Sulphat-Sulphur Content (to 60cm)	Sulphur Availability Category	Fertilizer Sulphur Recommended (kg/ha)		
		Crop Group*		
		1	2	3
0-11	Very Low	15	20	30
12-22	Low	15	20	30
23-33	Medium	0	20	30
34-44	High	0	0	0
45-66	Very High	0	0	0
67+	Very High +	0	0	0

* Crop Groups Include
#1 - Cereals, Flax, Buckwheat, Grasses
#2 - Canola, Mustard, Annual Legumes and other "special" annual crops
#3 - Perennial legumes (including grass- legume mixtures), Horticultural crops

Table 2. Variability in the Sulphate-Sulphur Content of Ten Fields Randomly Sampled in 1980

Field Number	Soil Sulphate-Sulphur Content (kg/ha) * Average	Range
1	18 (15)	10-32 (0)
2	18 (11)	16-24 (2)
3	19 (9)	8-35 (7)
4	34 (14)	16-48 (1)
5	34 (7)	30-55 (1)
6	34 (5)	17-57 (11)
7	36 (10)	19-66 (5)
8	39 (10)	27-71 (6)
9	45 (4)	36-51 (7)
10	53 (9)	39-68 (3)

* Based on results which were within the "normal" operating range of the analytical equipment. Number in parentheses in "Average" column indicates number of such samples. Number in paretheses in "Range" column indicates number of samples with values exceeding "normal" operating range of equipment.

Table 3. Percent of Fields Tested by the Manitoba Soil Testing Laboratory in Various Sulphur Availability Categories (Province Wide)

Year	% of Fields in Each Sulphur Availability Category			
	Very Low and Low	Medium	High	Very High and Very High +
STUBBLE FIELDS				
1979 - 1980	7	7	6	80
1980 - 1981	4	7	8	81
1981 - 1982	8	10	8	74
1982 - 1983	4	9	9	78
1983 - 1984	2	4	5	89
1984 - 1985	2	6	7	85
1985 - 1986	2	8	11	79
1986 - 1987*	4	10	9	77
FALLOW FIELDS				
1979 - 1980	5	5	6	84
1980 - 1981	3	7	10	80
1981 - 1982	6	10	11	73
1982 - 1983	4	9	11	76
1983 - 1984	2	4	6	88
1984 - 1985	2	7	8	83
1985 - 1986	0	7	11	82
1986 - 1987*	1	6	8	85

* To December 5, 1986.

Table 4. Percent of Fields Tested by the Manitoba Soil Testing Laboratory in Various Sulphur Availability Categories (Central Region)

Year	% of Fields in Each Sulphur Availability Category			
	Very Low and Low	Medium	High	Very High and Very High +
STUBBLE FIELDS				
1979 - 1980	10	6	6	78
1980 - 1981	4	6	7	83
1981 - 1982	8	11	10	71
1982 - 1983	5	9	9	76
1983 - 1984	1	3	4	92
1984 - 1985	3	7	8	82
1985 - 1986	2	7	11	80
1986 - 1987*	3	8	8	81
FALLOW FIELDS				
1979 - 1980	3	4	1	92
1980 - 1981	2	5	8	85
1981 - 1982	8	4	10	78
1982 - 1983	4	5	6	85
1983 - 1984	3	2	5	90
1984 - 1985	8	10	6	76
1985 - 1986	0	4	15	81
1986 - 1987*	0	0	1	99

* To December 5, 1986.

Table 5. Percent of Fields Tested by the Manitoba Soil Testing Laboratory in Various Sulphur Availability Categories (Interlake Region)

Year	% of Fields in Each Sulphur Availability Category			
	Very Low and Low	Medium	High	Very High and Very High +
STUBBLE FIELDS				
1979 - 1980	8	12	5	75
1980 - 1981	4	11	13	72
1981 - 1982	16	16	12	56
1982 - 1983	8	15	12	65
1983 - 1984	3	4	6	87
1984 - 1985	3	7	14	76
1985 - 1986	3	16	17	64
1986 - 1987*	2	11	11	76
FALLOW FIELDS				
1979 - 1980	2	5	7	86
1980 - 1981	10	12	20	58
1981 - 1982	7	16	4	73
1982 - 1983	9	14	12	65
1983 - 1984	3	2	10	85
1984 - 1985	2	7	6	85
1985 - 1986	0	7	14	79
1986 - 1987*	1	0	10	89

* To December 5, 1986.

Table 6. Percent of Fields Tested by the Manitoba Soil Testing Laboratory in Various Sulphur Availability Categories (Eastern Region)

Year	% of Fields in Each Sulphur Availability Category			
	Very Low and Low	Medium	High	Very High and Very High +
STUBBLE FIELDS				
1979 - 1980	3	7	5	85
1980 - 1981	4	8	7	81
1981 - 1982	7	9	11	73
1982 - 1983	3	10	11	76
1983 - 1984	2	5	6	87
1984 - 1985	1	6	9	84
1985 - 1986	1	3	9	87
1986 - 1987*	2	5	10	83
FALLOW FIELDS				
1979 - 1980	0	2	7	91
1980 - 1981	3	0	6	91
1981 - 1982	7	7	9	77
1982 - 1983	2	12	7	79
1983 - 1984	0	2	1	97
1984 - 1985	0	8	6	86
1985 - 1986	0	12	0	88
1986 - 1987*	0	1	6	93

* To December 5, 1986.

Table 7. Percent of Fields Tested by the Manitoba Soil Testing Laboratory in Various Sulphur Availability Categories (SouthWest Region)

Year	% of Fields in Each Sulphur Availability Category			
	Very Low and Low	Medium	High	Very High and Very High +
STUBBLE FIELDS				
1979 - 1980	5	4	4	87
1980 - 1981	4	6	7	83
1981 - 1982	7	8	6	79
1982 - 1983	3	8	5	84
1983 - 1984	2	5	5	88
1984 - 1985	1	4	5	90
1985 - 1986	0	7	11	82
1986 - 1987*	6	12	8	74
FALLOW FIELDS				
1979 - 1980	3	6	5	86
1980 - 1981	4	7	9	80
1981 - 1982	7	12	12	69
1982 - 1983	1	7	12	80
1983 - 1984	3	7	9	81
1984 - 1985	0	5	6	89
1985 - 1986	1	5	9	85
1986 - 1987*	3	14	8	75

* To December 5, 1986.

Table 8. Percent of Fields Tested by the Manitoba Soil Testing Laboratory in Various Sulphur Availability Categories (NorthWest Region)

Year	% of Fields in Each Sulphur Availability Category			
	Very Low and Low	Medium	High	Very High and Very High +
STUBBLE FIELDS				
1979 - 1980	8	11	8	73
1980 - 1981	2	7	8	83
1981 - 1982	8	12	9	71
1982 - 1983	3	11	12	74
1983 - 1984	2	4	6	88
1984 - 1985	2	5	7	86
1985 - 1986	3	8	13	76
1986 - 1987*	4	12	11	73
FALLOW FIELDS				
1979 - 1980	10	5	10	75
1980 - 1981	3	10	13	74
1981 - 1982	4	11	10	75
1982 - 1983	5	10	14	71
1983 - 1984	2	1	3	72
1984 - 1985	2	7	14	77
1985 - 1986	0	7	12	81
1986 - 1987*	0	20	10	70

* To December 5, 1986.

A STRATEGY FOR AGRICULTURAL SOIL AND WATER MANAGEMENT IN MANITOBA

What is a strategy? Webster's definition includes "a careful plan or method; the act of devising or employing plans or strategems towards a goal". A strategy then includes the identification of goals along with plans or methods with which you hope to achieve those goals. We have found that it is useful in addition to provide a brief background which provides a basis for the strategy. It is also useful to outline evaluation criteria to assist us in measuring the results of the strategy.

As world population increases and as humans learn to use more sophisticated technology the importance of planning or lack of planning becomes more important. Well developed strategies are more important now than ever before, and they will continue to become even more important in the future.

In developing a strategy the input of people knowledgeable in the area of the strategy is important. Also consultation with the public with particular focus on the people most affected by the strategy results is important.

I would like to spend the next few minutes outlining first the main components of "A Strategy for Agricultural Soil and Water Management in Manitoba", and secondly, a review of the current status of that strategy. Then I will sum up with some observations on where to go from here.

The soil and water strategy was drafted in 1984 and was based on the growing concerns with regard to the productivity of our land being threatened by wind and water erosion, reducing organic matter, insufficient or excess water, inefficient use of existing soil moisture and increasing soil salinity.

Objectives or goals identified were:

(a) To reduce soil and water management constraints to agricultural production;

(b) To provide social and economic benefits by improving the sustained productivity of our land base through (1) reducing soil erosion; (2) stabilization of soil organic matter; (3) developing efficient drainage systems; (4) efficient use of available soil moisture; and (5) management of saline soils.

(c) To develop an ongoing working and financial arrangement among the municipal, provincial and federal governments with respect to soil and water management.

The Strategy envisioned using the following methods:

(a) Research, (b) Conservation Districts, (c) Conservation District Commission, (d) Tri-level government participation, (e) Demonstration, and (f) Individual consultation and farm planning. Under each of these headings a number of more specific methods were identified.

A number of components were identified for evaluation purposes.

(1) The extent to which a tri-level government working and financial arrangement has been achieved.
(2) Evaluation of research activities in relation to the information developed, relevancy to present constraint and to its ability to provide useful data and information in a reasonable timeframe.
(3) Were new conservation districts established and results achieved by district.
(4) The degree to which erosion control, organic matter stabilization, drainage systems, moisture utilization and salinity control were demonstrated, farmer response and adoption, changes in knowledge and attitudes of farmers, municipal and provincial personnel.
(5) Number of farms receiving consultation and developing plans. Effect on individual farm resource planning on crop and livestock production.

A review of the current status of the Soil and Water Strategy implementation follows:

1. RESEARCH

(a) Soil Science Department - University of Manitoba

- to determine yield reduction as a result of soil erosion - 6 plots (Gladstone, Altamont, Minnedosa, St. Claude, Boissevain, Waskada).
- to test the validity of the Universal Soil Loss Equation - two run-off plots, one at Miami, one at Boissevain
- to study erosion and organic matter loss on sandy soils - (this work will be done on the Almasippi soils in the MacGregor area)
- to develop fertilizer recommendations which support economic crop production on peat soils - (This work is being done in conjunction with the Department of Soil Science, University of Manitoba.)

(b) Agriculture Canada Research Station, Brandon

- to evaluate fertility requirements on eroded, non-eroded and depressional areas on till soils.

(c) Tillage Research

- an Agri-Food proposal has been submitted by the Soils Dept. U of M to conduct research on the impact of O-till, minimum till and conventional tillage on various soil physical and chemical properties - this project, if approved, will be done on three soil types - clays, loams, sands.

2. CONSERVATION DISTRICTS

(a) There are five conservation districts in operation encompassing some 18% of Agri-Manitoba. The soil conservation budget in these areas amounts to about $325,000 per year. (Cooks Creek, Alonsa, Turtle River, Whitemud River, Turtle Mountain)

(b) Five areas have been designated as target areas for new conservation districts. (Pasquia, Cowan, Washow Bay, Deerwood, Elgin). The areas represent a wide range of integrated soil and water management issues. Local associations have been established in these areas under the current Agri-Food agreement. Concentrated effort will be made to formalize these proposed districts within the next four years.

(c) At least four additional areas have shown interest in the Conservation District program as a means of dealing with their soil and water management issues. (R.M.'s in the Pembina Valley; 3 R.M.'s in the Portage - Elm Creek - St. Claude area; the northwest Interlake; La Broquerie).

(d) A Conservation Districts Authority has been established. This group is responsible for the provision of financial and planning support to Conservation Districts. (Dr. Ian Dickson, Executive Director; a senior and junior resource planner; a hydrologist; an extension specialist; an accountant)

3. CONSERVATION DISTRICTS COMMISSION

- Membership
  - Director of Water Resources - Chairman
  - Deputy Minister, Municipal Affairs
  - ADM, Natural Resources
  - Chief, Soil & Water Management, Manitoba Agriculture
  - Chairman, Conservation Districts Association
  - Representative, Union of Manitoba Municipalities
  - Citizen Representative

- Commission's role is to administer the Conservation Districts Act.

4. TRI-LEVEL GOVERNMENT PARTICIPATION

(a) Manitoba Agriculture - PFRA Liaison Committee - four members from PFRA, four from Manitoba Agriculture.
- to coordinate the activities of provincial and federal soil and water programs in Manitoba.

(b) The involvement of municipal governments in the formation and operation of conservation districts. (R.M.'s must initiate the request for formation of C.D.'s) - in planning and implementation of drainage and/or water conservation programs. (R.M.'s must give approval for projects and must agree to cooperate with the province in completion of primary and secondary drainage network.) - in the planning and planting of field shelterbelts. (Concern about snowbanks on school roads.)

Three examples of projects:

(1) Tobacco Creek - (Proposed conservation district)

- Federal Government is providing funds to build headwater control structures and to encourage conservation tillage.
- Provincial Government is providing funds to administer the project and for various conservation activities.
- Municipal Government is providing contacts and a coordinating function.

(2) Pasquia - (Proposed conservation district)

- Federal Government is constructing the pumping stations.
- Provincial Government is constructing the main drainage infrastructure.
- Both agencies are supporting on-farm soil and water management projects.

(3) Existing Conservation Districts

- Annual provincial grant - $1.9 million constitutes 75% of C.D.'s working budget.
- Municipalities raise 25% of the operating funds of a District through tax levy.
- Farmers pay 15 - 25% of costs on on-farm projects.

5. DEMONSTRATIONS

- 25 soil and water demonstration projects have been established under the Agri-Food Program.

These include:

- 8 reduced tillage demonstrations where 0-tillage, minimum tillage (one operation between harvest and seeding) and conventional tillage are being compared on a field scale basis. Crop yields, soil moisture, fertility requirements, weed growth are being monitored.

- 3 soil salinity demonstrations (some started under Agro-Man but being continued). The projects include detailed soil salinity mapping, crop adaptation, including forages and cereals, yield analyses. Yield curves will be developed for various crops under various concentrations of salinity.

- integrated structural and land use headwater control demonstration (Deerwood) - 12 headwater control dams have been constructed - 2 0-till drills have been leased and are available for Association members use.

- runoff and impact on downstream flooding will be monitored. Elgin Plains has similar program but not as far ahead.

- conservation tillage is a major activity in all Agri-Food Associations. Most Associations have either leased or bought a 0-till drill.

- crop residue management is being demonstrated in the Interlake and Northwest Region, Elgin Plains.

- gully stabilization is being demonstrated in six Agri-Food projects, e.g. Pembina, St. Alphonse, Bruxelles, Minitonas, Deerwood, Cowan.

- field shelterbelts are major programs in Winkler, Dufferin, Turtle River, Elgin Plains, South Interlake Agri-Food projects. This program is to demonstrate wind erosion control in areas of light soil and where special crops such as potatoes, sugarbeets and vegetables constitute a major acreage.

6. FARM CONSULTATION

- some 47 farmers advised on on-farm water management - fields surveyed and drains designed.
- 8 drainage schools trained 50 farmers to conduct own on-farm surveys.
- 14 irrigation contacts.
- staff attended 100 rural extension meetings - contacted 3,905 farmers.

In summary the Strategy has resulted in alot of activities in a short period of time. These activities have been made possible in large measure because of the Agri-Food Agreement. The results of this activity will be evaluated against the original goals of the Strategy. However, the cooperative effort of organizing to enhance our soil productivity and to prevent soil degradation has been substantial.

Manitoba Agriculture is presently in the process of developing a number of Strategies in the areas of Forages, Cereals and Oilseed Crops, Beef, Swine and Farm Family Management. We look forward to wide consultation and cooperation in these endeavors.